SCIENCE

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CONTENTS:

*SOME PRESENT POSSIBILITIES IN THE ANALYSIS OF IRON AND STEEL.**

To the analytical chemist there are few substances in nature more interesting than a piece of pig iron, few substances which have received more study, and few which present chemical problems more difficult of solution. The amount of work which has already been done in connection with this very common but very complex substance is something enormous. Indeed, if we add to the study which has already been put on pig iron itself the work which has been done on what may perhaps fairly be called its progenitors, *viz.*, the ores, the fuel, the flux and the refractory materials used in its production, and then consider still further the labor already expended in the analysis of what we may call the progeny of pig iron, *viz.*, castings, wrought iron, malleable iron and the numerous grades and kinds of steel, made by the various processes of the present day, we shall surely be safe in saying that more chemical work has been done in connection with pig iron than with any other substance in nature. Is it too much to affirm that at the present time one-third, possibly one-half, of all the chemical work done in the world is in connection with the iron industry, either in the solution of unworked-out problems, the

* Presidential address delivered at the Troy meeting of the American Chemical Society, December 29, 1896.

development of new methods of analysis, or in the routine analyses affecting the interests of producer and consumer.

But the amount of work already done and in daily progress in connection with this substance is not all that may be said in regard to it. The complexity of pig iron is very great, and consequently the analytical problems presented are far from being easy of solution. It may not be uninteresting to enumerate some of the substances which have already been found in pig iron. We find, besides the element iron, carbon, phosphorus, silicon, sulphur, manganese, copper, chromium, tungsten, titanium, vanadium, nickel, cobalt, aluminum, potassium, sodium, magnesium, calcium and lithium. It is fair to say that there is apparently well grounded belief that the last five are characteristic of intermingled slag, rather than of the metal itself. It is not intended that it should be understood that all of these substances have been found in any one sample of pig iron, but that all these substances have actually been detected in the analysis of this alloy. Indeed, there seems no reason why any element which either occurs in the metallic condition in nature or which is reducible to that condition by carbon, and which is not volatile at the temperature of the blast furnace, may not occur in pig iron, provided, of course, it will alloy with the metal. Quite a large number of other substances besides those mentioned above have actually been alloyed with some form of iron or steel. Among these may be mentioned zinc, tin, lead, antimony, bismuth, molybdenum, silver, platinum, rhodium, irridium, palladium and gold. Nor is this all that may confront the analyst who devotes himself to the chemistry of iron and steel. Not less than three elements which usually exist in nature in the gaseous form occur in these metals, and are believed to have important influences on their physical properties. These are oxygen, hydrogen and nitrogen; while the numerous analyses show that the presence of carbon monoxide in both cast iron, wrought iron and steel. It seems quite evident that the chemist who hopes to cope successfully with the problems which are involved in even the ultimate analysis of iron and steel in their various forms must be well equipped with a liberal share of the methods and processes known to mineral chemistry, and, on the other hand, if he attempt the proximate analysis of these substances, or the separation and determination of the various compounds of the elements present, with iron or with each other, he will, at least, be brought on the border ground of organic chemistry. Some of the carbon compounds which are characteristic of the brilliant work of the present President of the French Chemical Society are known to occur in or have already been isolated from pig-iron.

It would lead us too far from our present purpose to do anything more than enumerate the largest number of the elements given above. Suffice it to say that in what follows we shall confine ourselves to the five first mentioned; *viz.*, carbon, phosphorus, silicon, sulphur and manganese. And the question which we shall ask ourselves is, 'What is the present condition of a portion of the analytical methods for the determination of these substances, considering these methods both in regard to their accuracy and speed?' One word of precaution. It would be manifestly impossible to comment on all the methods in use for determining these constituents. To enumerate them alone would weary your patience. We shall confine ourselves, therefore, principally to methods which may be or are used when the diverse interests of producer and consumer are involved.

Beginning, then, with total carbon in pig iron, wrought iron and steel, we deem it safe to say that the method by combustion

in oxygen gas, as at present known and worked in many laboratories, leaves very little to be desired, so far as accuracy is concerned, and is sufficiently rapid for most commercial uses. The modification introduced some years ago, of using a solution of the double chloride of copper and ammonium, instead of simple chloride of copper,* to release the carbon from the iron, took away from the combustion method one of its greatest difficulties; *viz.*, the long time required to dissolve the metal. The modification, as many will doubtless remember, reduced the time required for solution, from two or three days to an hour or less. Indeed, at the present time, if a good stirring machine is used, it is quite possible to dissolve three grams of fairly fine borings of pig iron, wrought iron or steel, in 200 cc. of the proper solvent in from ten to forty minutes.

Still further the studies of the Committee of International Standards for the Analysis of Iron and Steel have further modified the method, and it is believed rendered it much more accurate. Among these modifications may be mentioned the use of an acid instead of a neutral or basic solution of the double salt to dissolve the metal This point was thoroughly worked out by Blair.† Following this came the work done in the laboratory of the Pennsylvania Railroad Company,‡ demonstrating the unreliability of the use of the double chloride of copper and ammonia as a solvent, owing, as appeared later, to the probable presence in all ammonia and its salts, obtainable in the market, even those marked 'C. P.', of some carbonaceous material, possibly pyridine, derived from the gas liquor used in making the ammonia.

The substitution of the potassium * for the ammonium salt has apparently completely overcome this difficulty, and this with the use of oxygen gas instead of lead chromate, in which to burn the carbon, and some modifications of the absorbing and purifying train, have seemingly placed the dry combustion method for determining carbon in the front rank of successful and accurate analytical processes. The principal known source of error in the method at the present time appears to be in connection with the weighing. The potash bulbs and small calcium chloride tube used in absorbing the carbon dioxide weigh, altogether, some fifty to sixty grams, and present considerable surface. If now, between the weighing before the combustion and the weighing after the combustion, the interval being an hour, or a little more, there is considerable change in the hygroscopic condition of the atmosphere, an error of 0.01 per cent. may be easily introduced. If we may trust our experience, it is difficult to make closely agreeing duplicate combustions in showery weather. Blair suggests a method of overcoming this difficulty, consisting in having a second potash bulb and chloride of calcium tube of, as near as possible, the same size on the opposite end of the balance when weighing.

In regard to the accuracy of the method as at present understood, it may be said that, undoubtedly, the best test of the accuracy of a method is the recovery of a known amount of any substance added to the material to be analyzed. This procedure

* It is difficult to say positively who first suggested this modification. The first mention in literature that we are able to find is in the *Transactions of the American Institute of Mining Engineers*, 4, 157, by J. B. Pearse. But a private communication from Andrew S. McCreath states that he made the suggestion while working under Pearse, and that Professor Richter, in the Leoben Jahrbuch, had previously suggested the use of potassium or sodium chloride with copper chloride, which led him to try the ammonium salt. McCreath's description of the method as used by himself is published in the *Transactions of the American Institute of Mining Engineers*, 5, 575.

†*Trans. Am. Inst. Mining Eng.*, 19, 614.

‡*Trans. Am. Inst. Mining Eng.*, 20, 242.

**J. Am. Chem. Soc.*, 15, 448.

being manifestly impossible in the case of iron and steel, we are compelled to judge of the accuracy of the combustion method, as applied to these metals, in some other way. For this purpose, however, we have at hand the results obtained by different chemists, using different methods, but working on the same samples. In the course of the work done by the Committee on International Standards for the Analysis of Iron and Steel, the carbon in four samples of steel was determined: First, by using acid double chloride of copper and potassium as solvent and burning in oxygen gas; Second, by using the same solvent and burning in chromic acid solution; and Third, by treating the borings direct with bisulphate of potash and heat, conducting the carbon monoxide and sulphur dioxide formed over hot solid chromic acid, which oxidized both gases and retained the sulphur trioxide formed, and finally measuring the volumes of the resulting carbon dioxide in an eudiometer tube. Each method was used by a different chemist. The results obtained are as follows: the letters at the side representing the four samples of steel, the figures at the top representing the chemists, and the figures in the columns the percentages of carbon in the steel samples:

	1.	2.	3.
A	1.455*	1.440*	1.450†
B	0.815	0.800	0.815
C	0.450	0.450	0.448
D	0.152	0.185	0.168

The agreement of the results on the first three samples is quite marked. The discrepancy on the fourth sample has not been explained. The matter is discussed in considerable detail in reference 1, but we think it safe to conclude that, so far as method goes, the determination of total carbon in pig or cast iron, wrought iron and steel, is reasonably accurate.

**Proc Eng of Western Penna.*; 9 [9], 35.
†*Ztschr. anorg. Chem.*, 4 [3], und [4], 505.

The speed of the combustion method as at present worked in good laboratories is quite remarkable, compared with the possibilities twenty-five years ago. A sufficient supply of sample borings being at hand, one operator using two furnaces may readily make from fourteen to sixteen combustions in a day of eight hours, it being understood that the bulbs are weighed with oxygen gas in them instead of air, and that the last weight of each combustion, except the last one at night, is taken as the first weight of the succeeding one. It is, of course, assumed that, when turning out the amount of work above described, the furnaces and apparatus are all in good order, and everything working well. Accidents, an occasional overhauling of the apparatus, blank combustions from time to time for testing purposes, and once in a while an obstinate steel that refuses to dissolve in time or gives trouble in filtration, will all tend to diminish output. The results obtained with this rapid work show, when duplicates are made, occasional discrepancies as high as three hundredths of a per cent. in a steel containing one per cent. of carbon, but we have seen very large numbers of duplicates, made as above described, which did not disagree one one-hundredth.

Again, when work is not so plentiful as to admit of the procedure described above, the method still permits satisfactory speed. Starting with a fresh sample of borings and everything in good order, but cold, it is not difficult to get two closely agreeing determinations on the same sample in two hours and a half. Of course, in investigation or referee work more time would, undoubtedly, be used, especially if the interests involved are very great. But we have many times been astonished, in our own laboratory, at the close agreement between the results obtained in the rapid manner described above, and the duplicate analysis made on the same sample for confirmatory

purposes, but using much more time and pains.

Turning now to the determination of combined carbon and graphite, we do not find the state of affairs so satisfactory. As is well known, these two constituents are usually found by first determining total carbon, then dissolving another portion of the sample in hydrochloric acid, filtering and washing with caustic potash, alcohol and ether, and then burning the residue, collecting and weighing the carbon dioxide formed, as in an ordinary combustion. The result is called graphite, and the combined carbon is the difference between the total carbon and the graphite. But as Shimer* has so well shown, what we actually get by this procedure is not necessarily the graphite and the total combined carbon in the sample, but only the combined carbon which exists in the metal as a carbide soluble in hydrochloric acid. If the sample contains carbides not soluble in that acid, nor in the materials used in washing, the carbon of these carbides appears with and is counted as graphite. Shimer shows that titanium, and possibly vanadium carbide, are apparently not infrequently thus counted. The use of sulphuric instead of hydrochloric acid leads to the same error, while the employment of nitric acid as solvent apparently gives the graphite much more definitely, but leaves us in doubt as to whether the combined carbon is really the combined carbon which we want, in order to have light on the quality of the metal we are dealing with. It is obvious that the difficulty here is in our lack of knowledge as to what carbides actually exist in pig and cast iron, and, if there are several of them, which one or ones do we actually want to know the carbon content of. If we knew positively that the combined carbon wanted was that which exists in the metal as carbides of iron and manganese, and that these carbides were soluble in hydrochloric or sulphuric acid, while all other carbides present were not soluble in these acids, obviously we should use these acids when determining combined carbon. On the other hand, if we want to know only graphite, and care little about the combined carbon, apparently nitric acid is the solvent to use. It is clear that much more work is needed on this subject, a state of affairs which, as we progress, we shall find is characteristic of other constituents of the metals we are considering.

* *Trans. Am. Inst. Min. Eng.*, 25, 395.

Much might be said in regard to the color test for determining carbon in steel. It is difficult to over-estimate the value and importance of this method, especially in the daily operation of steel works, and there seems little doubt but that, if proper precautions are employed, the method, in skillful hands, will give results that are fairly reliable to within three or four hundreths of a per cent. It would hardly be possible in this paper to discuss all the precautions which are deemed essential by those best informed. A chemist of wide experience with the method has enumerated twenty-four points that must be observed if reliable results are to be expected. Let it suffice for us to say that even approximate accuracy cannot be expected:

1. If the steel whose carbon is to be determined and the standard steel do not have their carbon in the same condition. For example, if the standard steel has been annealed, and the sample to be tested has been tempered, the results will be worthless.

2. If the attempt is made to determine the carbon in any steel by using a standard widely different from it in carbon content. Using a 0.20 per cent. carbon standard, with a steel containing 0.50 or 0.60 per cent., is apt to lead to very fallacious results.

The best results seem to be obtained by having the carbon in all steels, both standards and tests, in the condition given by annealing, by having a number of standards which differ little from each other in carbon content, and by not attempting to use the method on steels containing very little or very large amounts of carbon. It may not be amiss to add here that the practice, so prevalent in many of the steel works, of using this method for all carbon determinations, including those where contracts are involved, is reprehensible and should be discontinued. The chemist at the works does the best he can with the method he is using, and the amount of work required of him, as well as the facilities furnished, do not admit of the use of a better method. On the other hand, when a dispute arises, and it is ultimately shown that the works are in error, the chemist is blamed and analytical chemistry brought into disrepute, not because either is really at fault, but because more is expected of the color test method than it is really able to give. To the steel makers we say, "Do not expect your chemist to render you the bricks of good chemical analyses, unless you give him the requisite straw of time and appliances to do good chemical work."

Few of the constituents of iron and steel have more important influences on their valuable qualties than phosphorus, and upon few has more chemical work been done. The present condition of the methods for determining this constituent seems fairly satisfactory, provided we are willing to take time enough to do the work. In confirmation of this statement, the work* done by the Sub-committee on Methods of the International Committee on Standards for the Analysis of Iron and Steel may be cited. This sub-committee consisted of five members, each of whom analyzed five samples of steel, and each used his own method, without any attempt at consultation or agreement with each other before the work was done. The methods employed may be briefly indicated as follows, those interested being referred to the report of the committee published as per the reference given for the details. Mr. Blair used what is known as the acetate method. Mr. Shimer used the molybdate-magnesia method. Your speaker used a combination of the acetate and molybdate-magnesia method. Dr. Drown used a combination of certain features of the modern rapid methods of the molybdate-magnesia method. And Mr. Barba on one sample used the acetate method as described by Blair, and on the other four samples employed certain features of the molybdate method to separate the phosphorous from the iron, and then used the reductor to get the amount of phosphorus, instead of weighing as magnesium pyrophosphate. It will be evident, to any one carefully reading the report referred to, that the methods employed differed widely in principle, in strength of solutions and in manipulation, and yet these methods gave the following percentages of phosphorus in the five samples:

	1.	2.	3.	4.	5.
Mr. W. P. Barba,	0.041	0.015	0.095	0.091	0.041
Mr. A. A. Blair,	0.040	0.016	0.098	0.091	0.041
Dr. T. M. Drown,	0.042	0.016	0.104	0.090	0.042
Dr. C. B. Dudley,	0.040	0.016	0.099	0.097	0.039
Mr. P. W. Shimer,	0.041	0.017	0.098	0.096	0.039

In explanation of the results, we quote from the report of the sub-committee:

"Sample No. 1 is an ordinary open-hearth steel. Sample No. 2 is a crucible steel. Sample No. 3 is an open-hearth steel to which metallic arsenic was added while in the molten condition in a crucible. Sample No. 4 is an ordinary Bessemer rail steel. Sample No. 5 is the No. 5 sample of the Committee on International Standards, and is an open-hearth steel.

"It will be observed that the agreement in the results on phosphorus obtained by

Proc. Am. Soc. Civil Eng., 21, 59.

the different chemists is very good. The exceptions are the No. 3 steel, which contains arsenic in considerable amount, and where the discrepancy is 0.009 per cent., and in the No. 4 steel, where the discrepancy is 0.007 per cent. Considerable work was done on the No. 4 sample, in an effort to reconcile discrepancies, and it was found that the turnings from this sample were irregular, and that two different bottles of the sample gave different results. The average of six determinations from one bottle was 0.1057, and the average of five determinations from another bottle was 0.0964 per cent. Furthermore, siftings from quite an amount of the turnings gave 0.140 per cent."

But these methods are long and laborious. It would be impossible with the most rapid of them to get a result in much less than a day, while two days would certainly be required for some of the others. Accordingly, since the demand for rapid phosphorus determinations during the last ten or fifteen years has been very great, an enormous amount of work has been done in trying to meet this demand. Modification after modification has been introduced, and paper after paper published on the subject. It is, perhaps, not too much to say that few chemical journals that publish any original work at all have escaped three or four articles per year, on the determination of phosphorus in iron and steel, or on some phase of a rapid method for such determination. The result of all this work has apparently been constantly increased rapidity, with constantly greater approximations to accuracy. The present state of the matter is, perhaps, best shown by Thackray* in his paper, 'A Comparison of Recent Phosphorus Determinations in Steel.' This writer sent to some twenty-three different chemists borings from two different samples of steel, with a request to have the phosphorus determined in each sample, and a description of the method used sent with the results. Each chemist was told that samples had been sent to others, but no attempt was made to have any special method used. The chemists embraced a professor in a technical school, the chemist of a large consumer, a number of commercial chemists, and a number of chemists employed by steel and iron works. On one sample thirty-six different results were sent in, and on the other thirty-eight. Twenty-seven different methods were employed, some of the chemists sending in results by two and even three methods, and some sending duplicate determinations. The results obtained were obtained as follows, the figures being percentages of phosphorus in the steels:

Sample.	1.	2.
Average of all determinations	0.0496	0.0885
Highest result	0.055	0.091
Lowest result	0.045	0.076
Maximum difference	0.010	0.015

The methods employed may be divided on the basis of time required into three classes:

1st. Those which may be called rapid, and which give a result in two hours or less.

2d. Those which may be called slow, and which require considerably more than two hours, but still give a result the same day.

3d. Those which may be called very slow, and which do not give a result until the second day or later.

Thirteen results on each sample were given by 'rapid' methods, eleven on the No. 1 sample and twelve on the No. 2 sample by 'slow' methods, and twelve on the No. 1 and thirteen on the No. 2 by 'very slow' methods. Arranging the results in accordance with this classification of the methods, we have some very interesting data, the figures being as before, the percentages of phosphorus in the two steels:

* *Trans. Am. Inst. Min. Eng.*, 25, 370.

	R. method.		S. method.		V'y S. Method	
	1.	2.	1.	2.	1.	2.
Average of all determinations	0.0499	0.0840	0.0490	0.0826	0.0496	0.0837
Highest result	0.054	0.091	0.052	0.086	0.055	0.089
Lowest result	0.045	0.078	0.046	0.076	0.046	0.078
Maximum difference	0.009	0.013	0.006	0.010	0.009	0.011

To our minds these figures are very impressive. It is worthy of note:

1st. That the average results given by the 'rapid' methods only differ on either steel from the averages given by the 'slow' or 'very slow' methods, by a little over 0.001 of a per cent.

2d. That the maximum difference between the highest and lowest results given by the 'rapid' methods on either steel is but a trifle greater than is shown by the 'slow' or 'very slow' methods.

In other words, if we interpret these results correctly they show that the rapid methods for determining phosphorus in steel now known and used in many laboratories give results that are well-nigh as accurate and reliable as those yielded by the longer and more laborious methods, and it must not be forgotten that, although we have placed two hours as the time characterizing a rapid method, a number of the results given above were obtained by the use of methods which give a single determination in forty-five minutes, and enable one operator to make twenty phosphorus determinations in a day. We are free to say we do not believe such a showing would have been possible five years ago.

But these results still leave something to be desired. The discrepancy between the highest and the lowest result is still too great. It is, perhaps, a little hazardous to place limits, but we do not think the chemists of the country should be satisfied until they are in possession of a method or methods which are so carefully worked out and so well described that in the hands of different chemists of fair ability and experience results will be obtained by all, when working on the same steel, that will not differ from each other more than 0.003 per cent. The Sub-Committee on Methods of the International Committee on Standards for the Analysis of Iron and Steel, before referred to, have had in hand, now for some two years, studies on a rapid and accurate method for the determination of phosphorus in steel. It has been the hope of the Sub-Committee that the ideal above given would be attainable by this method. In reality, the work of the Sub-Committee has embraced an examination of almost every chemical point involved, taking very little, if anything, for granted, and checking and proving every step. The work is not yet quite ready for publication, one or two points remaining which are not entirely settled, and it has been deemed advisable to withhold the method until these are completely cleared up.

Some years ago, with the publication* of what is commonly known as Ford's method, the determination of manganese took a decided step forward, at least in this country, so far as speed is concerned. Previous to that time the long and laborious acetate method, which involved the separation of the iron from the manganese as basic acetate and subsequent precipitation of the manganese by means of bromine or as pyrophosphate, had held full sway. Ford's contribution consisted, as is well known, in separating the manganese from hot nitric acid solution of the iron or steel, by means of potassium chlorate, and Williams† added the modification, now in common use, of determining the separated oxide of manganese, by its action on a standard solution of ferrous sulphate or oxalic acid. This method, as now worked in many laboratories, gives a single result in forty minutes and two in an hour, and enables one operator to turn out twenty to twenty-five deter-

* *Trans. Am. Inst. Mining Eng.*, 9, 397.

† *Trans. Am. Inst. Mining Eng.*, 10, 100.

minations in a day. The accuracy of this method has been questioned. We are not aware of any recent symposium on manganese where different chemists using different methods have worked on the same steels. In our hands this method gives results closely agreeing with check work done by the more laborious and generally accepted accurate methods, provided the sample contains not more than three-fourths of a per cent. On samples containing over one per cent. of manganese the results are apt to be low, owing probably to the fact that the manganese does not separate from the nitric acid solution as manganese dioxide, but as some other oxide whose composition is not positively known. In the calculation it is customary to regard the separated oxide as manganese dioxide, and this leads to perceptible error on large amounts. Producers and consumers rarely contend much over manganese in steel, and methods for its determination have, perhaps, not received, on that account, all the attention they deserve. There is evident need of more work on this subject.

The methods for the determination of silicon can hardly be regarded as in a perfectly satisfactory condition. If evaporation to dryness, to render silica insoluble, is employed, the time required is considerable. If dehydration by means of sulphuric acid and heat, as suggested by Drown,* is employed, there are difficulties which interfere somewhat with accuracy. There seems little doubt but that in skilled hands, with sufficient care taken in the manipulation, a couple of determinations may be made on the same sample, using Drown's method, that will agree closely with each other and with results given by the longer and more laborious methods. On the other hand, where one operator is making a number of determinations at the same time there is much danger of error due either to failure to dehydrate sufficiently or to over-heating resulting in the formation of insoluble iron salts. Our experience indicates that the margin between these two extremes is not very wide, and that it is fully as frequent to have duplicates on the same sample disagree as to agree. Our observations point to the view that the difficulty of insufficient dehydration is due to the separation of iron salts as the sulphuric acid concentrates. These salts enclose gelatinous silica and prevent the dehydrating acid from getting at it. Unless great pains are taken, therefore, to secure this contact by sufficient stirring, the results will be low. If, by some modification, the iron salts could be kept in solution until the silica is rendered quite insoluble it would apparently be a decided step forward with this method. It may not be amiss here to call attention to the fact first noticed in the laboratory of the Pennsylvania Railroad Company,* that after the dehydration and subsequent dilution are finished, if an interval of a few hours is allowed to elapse before filtration, the silica will redissolve and the results be low. Apparently, as we are able to work the method, the silica is not completely dehydrated, but only sufficiently so that, if filtered at once, fairly accurate results will be obtained.

It is difficult to say anything positive about the speed and output of Drown's method. It is probably safe to say that a couple of determinations could be made in an hour and a half, but, on account of the difficulty mentioned above, the method does not lend itself well to working on a large number of samples at once, and consequently a large daily output is somewhat interfered with.

It must also be said of the methods for the determination of sulphur in iron and

* *Trans. Am. Inst. Min. Eng.*, 7, 346.

* Address to the members of the Chemical Section of the Engineers' Society, at Pittsburg, September 27, 1892, by C. B. Dudley, on 'Discrepancy in Chemical Work by Different Workers.'

steel that those most in use are hardly as satisfactory as could be desired. The studies of Phillips* conclusively show that when using the evolution method the whole of the sulphur content is not given off in such a form as to be retained by the usual means employed to catch the gas. It seems not too much not to say that it is hazardous to use the evolution method on pig or cast iron, even when fusion of the residue is employed.

The formation of unoxidizable gases containing sulphur in the application of the evolution method to steel has not, so far as our knowledge goes, yet been demonstrated, and accordingly the evolution method is still used largely on steels. But on pig and cast irons the oxidation method seems the only one applicable, and some recent studies of Blair, described in a paper at this meeting, indicate that on certain pig irons all the sulphur is not given even by this method, unless the graphitic residue is fused with sodium carbonate and niter. Both methods are somewhat slow, and there is need of further study. If some means could be found by which barium sulphate could be readily and accurately converted into sulphide, so that a volumetric method could be applied to this sulphide, it would be a decided step forward. The necessity in accurate work for purifying barium sulphate, as first obtained from almost any solution, by fusion and reprecipitation, adds quite considerably to the time required. With steels and two sets of evolution apparatus, using bromine for oxidation, two determinations may be made in two hours. With four sets of evolution apparatus one operator can make twelve determinations in a day. In these cases purification by fusion is not attempted. By the oxidation method on pig or cast iron two determinations require about five hours, while one operator, with a supply of borings ahead and sufficient appliances, can get from ten to twelve results in a day. With this output purification by fusion is not attempted. If this is done, the time for a pair of determinations must be extended an hour and a half, and the daily output would be cut down at least a third.

From what has preceded in this hasty and necessarily imperfect survey of a portion only of the analytical methods in use in the iron and steel industry, it is clearly evident that there still remains an enormous amount of work to be done in connection with methods. We have touched upon only five of the fifteen or twenty constituents occurring in and affecting the quality of iron and steel, and find the methods for determining even these more or less imperfect and needing more work. What will be our condition as chemists if, as seems probable, nickel, chromium, aluminum, tungsten, and the gases, oxygen, hydrogen and nitrogen, either free or combined, within the next few years, come into prominence as constituents of iron and steel, and are made elements in important commercial contracts? Still further thus far our methods are concerned almost entirely with the total content of the various constituents we are determining. We know very little about the compounds of the various constituents occurring in iron and steel, with the metal or with each other. Is the phosphorus present as phosphide or phosphate, or both? How besides as sulphide does the sulphur occur? Do the various carbides which are revealed by the microscope, and which are believed to be so closely dependent on the heat treatment which steel receives, and which are so intimately related to the value of the metal, differ from each other in carbon content, or only in crystalline form? Who will be the first to isolate any of these carbides? Who will first give us a practicable, accurate and

* *The Journal of the American Chemical Society*, 17, 891.

sufficiently rapid method for determining oxides in steel? Who will first completely investigate the relation between the chemistry and the chilling properties of cast iron? And who will first give us a study on the form in which nitrogen occurs in this metal, and a sufficiently rapid and accurate method for its determination? Truly the harvest of chemical work before us in connection with iron and steel is bounteous. Will the laborers be forthcoming to gather the harvest?

C. B. DUDLEY.

ALTOONA, PA.

TORONTO MEETING OF THE BRITISH ASSOCIATION.

THE local preparations for the meeting of the British Association for the Advancement of Science to be held this year in Toronto, commencing Wednesday, August 18th, have now after a year's work on the part of the various local committees reached a very advanced stage. The finance committee have been promised $27,500 to meet the expenses of the occasion. The sectional meetings are to take place in the buildings of the University of Toronto, which are centrally situated and which may be reached from all points of the city by means of the electric car system. As the University grounds are adjacent to the Queen's park and in the residential portion of the city, this arrangement will thus be a most agreeable one for the visitors. The Presidential addresses and the evening lectures will be delivered in Massey Hall, which has been recently erected and is capable of holding about four thousand auditors.

Perhaps the most difficult of all the arrangements have been those pertaining to the matter of steamship and railway rates, but in these also very satisfactory progress may be reported. The British visitors will have reduced rates by the Canadian lines from Liverpool. The Canadian railways have made very important reductions to members of the Association who will travel in Canada between July 1st and September 30th. The Canadian Pacific Railway will give special rates also to members who wish to visit the Northwest, British Columbia and the Pacific coast. A large number of special excursions have been organized, some of them to take place during the meeting, others immediately after its close. They will last from two days to three weeks, and as the weather will be cool, no doubt these trips will be exceedingly pleasant for the members.

The retiring President is Lord Lister, President of the Royal Society. The President-elect is Sir John Evans, K. C. B., Treasurer of the Royal Society, who will deliver the Presidential address on the evening of the opening day. The Council of the Association have chosen Presidents for the majority of the Sections. Those already appointed are: Mathematics and Physics, Professor A. R. Forsyth, M. A. D. Sc., F. R. S.; Chemistry, Professor William Ramsay, Ph. D., F. R. S.; Geology, G. M. Dawson, LL. D., F. R. S.; Zoology, Professor Louis C. Miall, F. L. S., F. R. S.; Economic Science and Statistics, Professor E. C. K. Gonner, M. A., F. S. S.; Anthropology, Professor Sir William Turner, LL. D., D. C. L., F. R. S.; Physiology, Professor Michael Foster, LL. D., Sec. R. S.; Botany, Professor H. Marshall Ward, D. Sc., F. R. S. Professor James Dewar, LL. D., F. R. S., and Mr. J. Milne, F. R. S. (late professor in the Imperial University of Tokyo) have been appointed to deliver the evening lectures.

Amongst those who have promised to attend are Lord Kelvin, Lord Lister, Sir Henry Roscoe, F. R. S.; Sir Robert Ball, Professors Viriamu Jones, LL. D., F. R. S.; G. Carey Foster, F. R. S.; J. S. Burdon-Sanderson, LL. D., F. R. S.; A. W. Rücker,

Sec. R. S., J. R. Green, F. R. S.; F. O. Bower, F. R. S.; A. C. Haddon, D. Sc., C.; S. Sherrington, F. R. S.; A. H. Miers, F. R. S.; W. A. Herdman, F. R. S.; S. P. Thompson, F. R. S.; S. H. Vines, F. R. S.; A. G. Vernon Harcourt, F. R. S.; C. Le-Neve Foster, F. R. S.; Mr. J. Scott Keltie, W. H. Preece, F. R. S.; W. H. Gaskell, F. R. S.

It is the intention of the Local Secretaries to issue invitations to a large number of representative foreign men of science to attend the meeting, and it is hoped that a number of these will accept. The presence of foreign scientific men has been a special feature of many of the meetings in recent years, and this has greatly increased the interest of the members and public in the Association, while it has given the latter a semi-international character. The Local Committee desire that the Toronto meeting shall be largely an international one, and they have welcomed the provision made by the Council of the Association whereby the fellows and the members of the American Association are given for 1897 the same standing as old members of the British Association, that is, they will on joining be required to pay $5 only, instead of $10, the amount exacted for new members. The officers of the American Association also have been made Honorary Members of the British Association. The presence of these and the attendence of from forty to fifty Continental (European) men of science will doubtless do much to realize the hopes of those who advocate the formation of an International Association for the Advancement of Science. In any case it will serve to widen the sympathies of the scientific men of the British Empire and of the Anglo-Saxon Republic. The local committee on the other hand will endeavor to make the meeting an extremely pleasant one for all the visitors.

The provisional program of the daily agenda of the meeting will be published in SCIENCE in a few weeks.

A. B. MACALLUM.

GEOLOGY AT THE BRITISH ASSOCIATION.

THE address of the President, Mr. J. E. Marr, was an eloquent and powerful appeal for the systematic pursuit of minute stratigraphical investigation. While petrology may be largely claimed by the Germans, paleontology by the French, and physical geology by the Americans, detailed stratigraphy has been much followed in Britain from the days of William Smith to the time of its present exponents, amongst whom we reckon Lapworth, Buckman, and, he might have added, himself.

Apart from the accurate unravelling of physical structure and the consequent correct knowledge of earth history which thus becomes possible, the President referred to a number of almost unforeseen results, which could only have been obtained when the succession of strata was studied in minute detail and the minor divisions of the rocks laid down on maps of sufficient scale. The detection of small faults and their relation to physical features and to denudation, the identity of ancient rocks and modern deposits, the history of coral reefs, the origin of coal seams, the geography of former periods, the distribution of ancient climates, the direction and nature of earth movement and its effect on the position and structure of igneous rocks, even the history of the crystalline schists —all these branches had received or might be expected to receive help from this line of enquiry. Dealing with the more immediate bearing of stratigraphical research on earth history and evolution and the phylogeny of organisms, he referred especially to the work of Barrande, Walcott, and Matthew on trilobites, of Lapworth on graptolities, of Beecher on

brachiopods, and of Jackson on echinids and lamellibranchs. In conclusion he appealed for a consideration of evolutionary geology against both catastrophism and uniformitarianism.

Sir W. Dawson's paper on 'Pre-Cambrian Fossils,' was of so much interest that we give his own abstract in full; the paper was illustrated by a very beautiful series of lantern slides.

The author stated that it was his object merely to introduce the specimens he proposed to exhibit, by a few remarks rendered necessary by the present confusion in the classification of pre-Cambrian rocks. He would take those of Canada and Newfoundland as at present best known, and locally connected with the specimens in question.

He referred first to the 'Olenellus Zone,' and its equivalent in New Brunswick, the 'Protolenus Fauna' of Matthew, as at present constituting the base of the Cambrian and terminating downward in barren sandstone. This Lower Cambrian had in North America, according to Walcott, afforded 165 species, including all the leading types of the marine invertebrates.

Below the Olenellus Zone, Matthew had found in New Brunswick a thick series of red and greenish slates, with conglomerate at the base. It has afforded no Trilobites, but contains a few fossils referable with some doubt to Worms, Mollusks, Ostracods, Brachiopods, Cytideans and Protozoa. It is regarded as equivalent to the Signal Hill and Random Sound Series of Murray and Howley in Newfoundland, and to the Kewenian, and the Chuar and Colorado Canyon Series of Walcott in the West. The latter contains laminated forms apparently similar to *Cryptozoon* of the Cambrian and *Archæozoon* of the Upper Laurentian.

The Etcheminian rests unconformably on the Huronian, a system for the most part of coarse clastic rocks with some igneous beds, but including slates, iron ores and limestones, which contain worm-burrows, sponge-spicules, and laminated forms comparable with *Cryptozoon* and *Eozoon*. The Huronian, first defined by Logan and Murray in the Georgian Bay of Lake Huron, has been recognized in many other localities, both in the west and east of Canada and the United States; but has been designated by many other local names, and has been by some writers included, with the Etcheminian and sometimes with part of the Laurentian, in the scarcely defined 'Algonkian' group of the United States Geological Survey.

Below the Huronian is the Upper Laurentian or Grenville system, consisting of gneisses and schists (some of which, as Adams has shown, have the chemical composition of Palæozoic slates), along with iron ore, graphite and apatite, and great bands of limestone, the whole evidently representing a long period of marine deposition, in an ocean whose bed was broken up and in part elevated before the production of the littoral clastics of the Huronian age. It is in one of the limestones of this system that, along with other possible fossils, the forms known as *Eozoon Canadense* have been found. The author did not propose to describe these remains, but merely to exhibit some microphotographs and slices illustrating their structure, referring to previous publications for details as to their characters and mode of occurrence.

Below the Grenvillian is the great thickness of Orthoclase gneiss of various textures, and alternating with bands of hornblende schist, constituting the Ottawa gneiss or Lower Laurentian of the Geological Survey. No limestones or indications of fossil remains have yet been found in this fundamental gneiss, which may be a truly primitive rock produced by aqueo-igneous or 'crenitic' action, before the commencement of regular sedimentation.

The author proposed, with Matthew, to regard the Etcheminian series and its equivalents as Pre-Cambrian, but still Paleozoic; and, as suggested by himself many years ago, to classify the Huronian and Grenvillian as *Eozoic*, leaving the term Archæan to be applied to the Lower Laurentian gneiss, until it also shall have afforded some indications of the presence of life.

He insisted on the duty of paleontologists to give more attention to the Pre-Cambrian rocks, in the hope of discovering connecting links with the Cambrian, and of finding the oceanic members of the Huronian, and less metamorphosed equivalents of the Upper Laurentian, and so of reaching backward to the actual beginning of life on our planet, should this prove to be attainable.

An extremely interesting paper by Dr. Matthew dealing with a kindred subject and entitled 'Some Features of the early Cambrian Faunas.'

The paper referred chiefly to the larval features of the early Cambrian Trilobites, because in them we may look for points of structure which will appear in the adult condition of their predecessors. But allusion was also made to the early Cambrian Brachiopoda and Ostracoda.

Trilobites.—Except in *Olenellus* and its allies the larval forms of the earliest trilobites are little known, but in those of the *Paradoxides* beds a number of series of the larval forms are known belonging to different genera, so that in these we have fuller data for comparison.

Cambrian time has been called the 'Age of Trilobites,' and their abundance and variety is truly remarkable. The flexibility of the type is indicated by the numerous genera that appeared successively in that early age. They thus become valuable in marking the divisions of the Cambrian rocks as the vertebrates do those of the Tertiary.

The utility of their remains is manifest in the ease and certainty with which different parts of the Cambrian System can be recognized in all the regions around the Atlantic Ocean, where rocks of this age have been found. This being the case, it may be profitable to examine the forms of the earliest Cambrian trilobites and note how they compare with the larvæ of those of the *Paradoxides* beds. The law of development would lead us to expect that in the *pre-Paradoxides* faunas of the Cambrian certain features of the larval forms of the trilobites of the *Paradoxides* beds should appear as permanent adult features in their predecessors. Let us see if such is the case.

In 1892 Dr. J. Bergeron summed up the evidence on this point, derivable from the trilobites of the *Paradoxides* and *Olenellus* faunas in his article 'Is the Primordial the most Ancient Fauna?'* He used the studies of Barrande, Walcott, Ford and others for this purpose, and his conclusion was that there must have been a more ancient fauna.

Discoveries of other faunas beside that of *Olenellus* have been made since Bergeron wrote upon this subject, and we may now place his theory against some additional facts which bear upon it.

To make the application clearer some of the characteristics of the earliest larval stages of the trilobites of the *Paradoxides* beds as shown in the young of *Paradoxides*, *Ptychoparia*, *Conocoryphe*, *Microdiscus* and *Agnostus* may be presented. Among them are the following:

1. Predominance of the cephalic over the caudal shield.

2. A long, narrow glabella, with nearly parallel sides. In these early moults the posterior lobes of the axial rachis (which includes the glabella) are short and weak compared with the anterior and especially the first.†

* Revue generale des sciences, Paris, 1892.

† *Paradoxides* is apparently an exception to this rule, but we do not know its earliest stages.

3. The eyes are absent; when they first appear they are near the lateral margin, and in several genera are elongated.

4. There are no movable cheeks; when these first appear they are narrow and marginal.

5. There is no thorax; this region begins with one segment, and in some genera never exceeds the number of 2 or 4. The pleuræ at first are short.

6. The pygidium at first is quite short and of one segment.

Three local faunas, all older than *Paradoxides*, have been made known since Bergeron wrote his paper referred to above. They all show more or less the increasing prevalence of larval features in the trilobites as we go back in time. J. C. Moberg has described a number of species from Sweden (including two species of *Olenellus*) in which some of the above larval characters are shown.

J. F. Pompeckz has just described a *pre-Paradoxides* fauna from Bohemia, in which are a few trilobites that carry larval characters. Thus his *Ptychoparia* is referred to the subgenus *Conocephalites*, probably because it has a long eye-lobe. It is a primitive form with short pleuræ, if we may judge from the short posterior extension of the dorsal suture. His *Solenopleura* also differs from that genus in its long eye-lobe and long glabella, but these also are larval features.* Another species of *Solenopleura*, however, cited by Pompeckz has shorter eye-lobes.

It is the *Protolenus* fauna of the St. John's group (Cambrian), however, which shows most decidedly larval traits in its adult trilobites.

Among these trilobites all (so far as their remains show it) have prolonged eye-lobes, a peculiarity which marks the early *Olenidæ*. Many of them have longitudinal glabellæ, also a larval character. Many have a short posterior extension of the dorsal suture, indicating the primitive feature of short pleuræ. Many have small and weak pygidia; this is inferred from the rarity of this part of the organism in the collections preserved.

Protolenus (typical), which has a general resemblance to *Paradoxides*, differs from it in the absence of a clavate glabella, and the small anterior lobe of this part of the head-shield, but these are characters found in the larval stages of *Paradoxides*.

A genus of this fauna, almost as common as *Protolenus*, is *Ellipsocephalus;* this genus also abounds with Protaspian peculiarities.

Lastly, we may refer to the genus *Micmacca*, which has the following larval features, longitudinal glabella, long eye-lobe and short posterior extension of the dorsal suture. If *Zacanthoides* of the Middle Cambrian were shorn of the long posterior extension of this suture and its long pleuræ it would not differ greatly from *Micmacca*.

In the *Olenellus* fauna also are genera, such as *Olenellus*, *Protypus*, *Avalonia* and *Olenelloides*, which retain marked larval characters.

Brachiopoda.—If we turn our attention to the Brachiopoda we note that they show a special development in the early Cambrian different from that of the *Paradoxides* beds and the later members of the Cambrian System.

The most notable feature is the large percentage of *Obolidæ* (including *Siphonotreta*). The older Cambrian holds, in common with the *Paradoxides* beds, the small shells of *Acrothele*, *Acrotreta* and *Linnarssonia;* but it also has a series of larger forms peculiar to it. Such are *Obolus Botsfordia*, *Trematobolus* and *Siphonotreta* of the *Protolenus* fauna, and *Schizambon* and *Micwitzia* of the *Olenellus* fauna. This great development of oboloid shells is not re-

*In the larval forms of *Ptychoparia* and *Solenopleura* of the *Paradoxides* beds, however, the eye-lobe is short.

peated in most countries until Ordovician time.

Not only are these old Cambrian faunas remarkable for the peculiar types of Brachiopods which they possess, but they are also remarkable for those they lack. A *Lingula* has not been found, though *Lingulella* is a common genus.

The larval growths of Ordovician and Silurian *Lingulæ* carry us back to a form which is oboloid. Thus in *L. quadrata, L. Howleyi*, etc., the shell is first circular as in *Obolus*, then oval as in *L. quebecensis*, etc., and finally takes on the sub-quadrate form of the adult shell. But there is a more elementary form of the Brachiopod shell than the circular shell of *Obolus;* this is seen in *Paterina* and the young shell of *Botsfordia*, which is nearly semicircular. Both these shells come from beds which are older than *Paradoxides*.

Ostracoda.—The Ostracoda also gives us definite forms peculiar to the early Cambrian beds. Such are the types represented in *Beyrichonia* and *Hipparicharion;* such also are those with flexible tests represented by *Aluta*. Other Ostracods are present in more varied forms than in the *Paradoxides* beds.

The distinctive features of the animals of the earliest Cambrian faunas may be summed up as follows:

1. The trilobites retain larval characteristics to an unusual degree.

2. The Brachiopods have a large percentage of oboloids.

3. The Ostracoda are plentiful and varied and present some peculiar types.

Another paper which will probably be of considerable interest in America is Dr. H. J. Johnston-Lavis' criticism on the work of Messrs. Weed and Pirsson on the Highwood Mountains. These writers describe Square Butte as a laccolite formed in Cretaceous sandstones and composed of an outer and upper layer of a basic rock that they name *shonkinite*, with a core of syenite. The shonkinite shows a laminated structure parallel to the roof, as was likewise the case with the upper part of the syenite. They consider this variation in the rock to show differentiation by diffusion and separation of the two magmas and that the lamination was due to the isotherms in the cooling mass. Dr. Johnston-Lavis showed that these interpretations were not in accord with the facts; if such differentiation had occurred, the line of junction of the two rocks should be roughly horizontal and not parallel to the roof, and he suggested that the lamination was due to shearing planes. His view was that the shonkinite had been delayed in the volcanic conduit and had been basified by osmotic action between the paste and the limestone or other basic rock-walls. This first filled the laccolite and was followed by the less basic or unaltered syenite from below. The white, dyke-like mass was an insuperable difficulty to the views of Messrs. Weed and Pirsson and only explicable by the theory of the present author.

Sir Archibald Geikie read a very interesting paper in which he recognized that some rocks previously described as volcanic agglomerates in Anglesey were in reality crush rocks, but a great deal of volcanic material had contributed to their original formation. Mr. Greenly also attributed the quartzite lenticles of the same island to a similar action upon beds of grit and sandstone. In a second paper he described the occurrence of Sillimanite-Gneisses in Anglesey. The curious mass of ancient rocks which is half submerged under the Trias of eastern England, at Charnwood Forest, was described in some detail by Mr. Watts, who attributed to it a Pre-Cambrian age. He further pointed out that a landscape at least as old as the Trias was here being gradually exposed to-day by the slow removal of the New Red Sandstone in which it was embeded.

A number of papers on subjects of local interest were read by Mr. Morton, Mr. Mellard Reade, Mr. Beasley and others, on the Trias and its footprints, the boulder clays, submerged forests, and on the advance of the sea upon the coast. Excursions were organized to most of the places mentioned in these papers and a long excursion to the Isle of Man conducted by Mr. Lamplugh and Prof. Boyd Dawkins, the latter of whom read a paper on the geology of the Island in which he described its Ordovician, Carboniferous, Permian, Triassic and Pleistocene deposits, together with the igneous rocks.

Messrs. Howard and Small made a communication on the nodular and felsites and other igneous rocks of Skomer Island, which they had determined to be interbedded lavas, associated with tuffs of Bala or Llandovery age. Mr. Garwood presented a report on the progress of his work on the zoning of the Lower Carboniferous rocks by means of their fossils, in which he showed that considerable progress had been made, but the inquiry was hampered by the variable character of what are at present regarded as species in the brachiopods and other organisms.

Mr. Wethered gave an illustrated lecture on the organisms characteristic of the chief limestones in our scale, and dwelt much on the evidence which tended to prove that oolitic structure was of organic origin.

Prof. Hull proposed a new theory to account for the glacial period. If the West Indian Islands were much upheaved at that period, as appears from Spencer's observations to have been the case, the Gulf Stream would no longer accumulate in the Gulf of Mexico and would in consequence reach the North Atlantic about ten degrees colder than it is at present. The amount of high land in the northern hemisphere at this time would also be a contributing cause.

Mr. Clement Reid gave an account of his excavations at the classic locality of Hoxne, in Suffolk, directed towards ascertaining the age of the Paleolithic implements discovered there. Under the top layer, which has yielded the implements, comes a series of lacustrine deposits, including a bed of lignite; these strata rest in a hollow denuded out of the boulder-clay, which in turn rests on sands and gravels. The estuarine beds indicate that the glacial climate of the boulder-clay was succeeded by a temperate climate and that by a second arctic climate before the implement-bearing beds were laid down. These determinations depend on the evidence derived from the relics of fossil plants, mostly seeds, found in the estuarine beds.

Mr. Kendall read a paper on the changes which many Yorkshire rivers had undergone in their courses since the glacial period. Both the Wharfe and the Nidd have been diverted from their old channels, which are still traceable, and now flow through gorges in the lower part of their courses. Similarly the Swale and the Wishe were once tributary to the Tees, though they now drain into the Derwent, which itself flows west from Scarborough, instead of east and straight to the sea. A vast amount of water has thus been brought to the Humber which did not originally belong to it. The usual discussions as to the origin of various glacial deposits between the advocates of marine action and those of land-ice work were rife on the day devoted to Pleistocene subjects, the battle ground shifting from the Isle of Man to the Vale of Clwyd and back again to Ayrshire and Kintyre.

Mr. Cornish gave the results of his work with the sand-blast and on ripple marks, in which he endeavored to distinguish between the forms caused by waves from those due to streams and wind. Prof. Milne described his seismographic work in

the Isle of Wight, where earth-tremors appear to be of constant occurrence, and stated that he had been able to feel certain tremors at a distance of several thousands of miles. Indeed, he went further and, calculating that one shock had reached his instruments from a distance of not less than 6,000 miles, he stated the extreme probability that a shock had occurred in Japan on August 31st, a prediction which was verified at the close of the meeting.

The Coral Reef Committee had to announce that so far as the boring at Funafuti went it was practically a failure, but that the results brought back by the scientific officers of the ship and by the three naturalists engaged in the investigation, were of very great importance from the points of view of anthropology, zoology, botany, geology and hydrography. The Geological Photographs Committee reported that a large part of Britain was now photographically registered in the collection of 1,400 prints which had been amassed, but there were many areas ill-represented and others almost as yet untouched. In conclusion, a discovery by Prof. Busz must not be omitted. Amongst some remarkable rocks produced by contact metamorphism round the Dartmoor granite mass he had found and isolated corundum in a felsite which had enclosed and metamorphosed a fragment of slate.

W. W. Watts.

London.

Relations of Tarsius to the Lemurs and Apes.

The systematic position of the Lemuroidea has for years puzzled the most eminent naturalists. The French zoologists, including Alphonse Milne-Edwards, Gervais and Filhol, consider the Lemurs as occupying a position entirely apart from the Apes, and moreover some of these observers find in the anatomy of the soft parts of the Lemurs close resemblances structurally to the same parts in the Ungulates. The conclusions of Filhol in regard to the position of the fossil Lemurs have not been generally accepted by paleontologists, and there is no doubt that certain characters of the dentition of *Adapis* which are like those of the perissodactyle Ungulates must be considered as cases of parallelism.

Years ago Mivart ably contended for the close affinity between the Apes and Lemurs, and Cope saw in *Anaptomorphus* the most simian lemur yet discovered. Schlosser, on paleontological grounds, derives the Anthropoids and Lemuroids from the same stem form.

Up to the present time the genus *Tarsius* has been considered to be a member of the Lemuroidea, but the recent investigations of Hubrecht on the placentation of *Tarsius* go to show that this genus has the same type of placenta as in the Apes. Accordingly Hubrecht would transfer *Tarsius* from the Lemuroid to the Anthropoid division of the Primates. In this removal of *Tarsius* to the Anthropoids, he proposes to include *Anaptomorphus*, and if the latter genus is placed among the Apes, why not place *Necrolemur* there too, as it has probably the same dental formula as *Tarsius*, and the modification of the anterior part of the dentition in *Necrolemur* resembles that of *Tarsius*.

It appears to me if this change in the classification of the Primates takes place we shall be little benefited and that it will be exceedingly difficult to discover any characters of the skeleton by which we can separate the Apes from the Lemurs. I hold that the summation of the osteological characters of *Tarsius* brings this form nearer the Lemurs than the Apes, and, moreover, I know of only one Anthropoid character in the skeleton of *Tarsius;* this is the partial closure inferiorly of the orbital fossa, by a lamina of bone extending from the alisphe-

noid to the malar. I admit this character occurs in no other known Lemuroid. However, in the fossil genera related to *Tarsius*, that is in *Anaptomorphus* and *Necrolemur*, this sphenoidal lamina in the skull is not present.

In support of the view that *Tarsius* is a generalized member of the Lemuroidea, I wish to enumerate a number of its most important dental and osteological characters: the lower incisors and canines are normal in form as in the extinct ancestral Lemurs, the lachrymal fossa is exposed as in the Lemurs, the fourth digit of the pes is longer than the third, the second digit of the pes is provided with a claw, and, lastly, the calcaneum and navicular are elongated as in *Galago* and *Cheirogaleus*. These characters are all those of the true Lemurs, and I believe they are essential. In regard to the presence of a claw on the second digit of the pes, that may be considered a primitive character, as in my opinion the Lemurs have been derived from an unguiculate form, and not from an ungulate type (*Condylarthra*).

I do not see that the characters of the dentition of *Tarsius* bear directly on the question as to its close relationship with the Apes. The upper molars of *Tarsius* are of the primitive tritubercular type, and the lower are tuberculo-sectorial. These types of teeth would be the primitive ones from which those of both the Apes and Lemurs were derived.

The form of the incisors and canines in *Anaptomorphus* is not known, but from the resemblance of the skull of *Anaptomorphus* to that of *Necrolemur* and *Tarsius* one might conclude that the anterior part of the dentition would be like that of *Tarsius*. In *Anaptomorphus homunculus*, as shown by Osborn and Wortman, there are three lower premolars, but in *A. aemulus* there are said to be only two. In other words, the last-named species is supposed to have the true simian dental formula, namely: I_2, C_1, Pm_3, M_3. I believe, however, that we may interpret the arrangement of the teeth in *Anaptomorphus aemulus* differently, and in that case the lower dental formula would read: I_1, C_1, Pm_3, M_3, or the same as in *Tarsius*.

The structure of the skull in *Necrolemur*, *Anaptomorphus* and *Tarsius* is very similar. In all we have greatly enlarged orbits and huge auditory bullæ. In comparing the teeth of these genera, we find that *Anaptomorphus* and *Tarsius* have retained the primitive tritubercular structure in their true molars, whereas in *Necrolemur* the superior molars are of the quadritubercular type, and the lower true molars have lost the antero-internal cusp. One character of the dentition of *Anaptomorphus*, as shown by Cope, relates this genus more closely to the Anthropoids than any other known Lemur; this is, that the third upper premolar has an internal cusp as in the Apes. With the exception of this special dental character, *Anaptomorphus* is a true Lemur.

In *Adapis* of the Upper Eocene of Europe the general structure of the Molars closely resembles that of the recent Lemurs, especially the genera *Lemur* and *Lepidolemur*. In *Adapis* however, the pattern of the last lower and upper premolar is nearly like that of the true molars; and on account of the complex structure of this tooth, *Adapis* has been excluded from the line leading to any of the recent Lemurs. This objection as to the *Adapidæ* being ancestral forms can now be removed, as there is a beautifully preserved skull in the collection of the Jardin des Plantes, Paris, from the Phosphorites, which represents a new genus of this family, and the last premolar in both jaws of this new type is perfectly simple in structure and of the same form as in the majority of recent Lemurs. This cranium is essentially that of a living Lemur, closely allied to

Hapalemur, but with one important exception, namely, the incisors and canines, are normal in form, and not proclivous, as in recent Lemurs. This is exactly what we should expect to find in an ancestral Lemur, as that peculiar modernization in the form of the lower incisors and canines in the Lemurs probably occurred at a very late geological epoch. In the jaw of *Megaladapis*, of the late Tertiary or Pleistocene epoch of Madagascar, the incisors are not preserved, but, from the extreme massiveness of the jaw symphysis and its upward bend, I think further discovery will show that in this form the lower anterior teeth were upright in position as in the Eocene Lemurs.

As already mentioned, the teeth of the Old World *Adapidæ* closely resemble those of the recent Lemuroidea, especially the forms included in the subfamily *Lemurinæ*. The American forms which are supposed to be related to Adapis cannot be considered as ancestral to any of the existing Lemurs, on account of the sexitubercular structure of their superior molars. The question is: Are these American genera monkeys? As before stated, it is very probable that the ancestral Lemur had a generalized type of dentition in that the incisors and canines were of the normal form, as in the Apes. The *Hyopsodontidæ* then can hardly be designated as monkeys, simply because they have retained, in the shape of their anterior teeth, the form common to to the ancestors of both monkeys and Lemurs. The term Pseudolemurs, which Schlosser has proposed to apply to fossil Lemurs, with the full number of premolars, is appropriate especially for the American fossil lemurines. Moreover, this name has the advantage of showing that these forms are not directly ancestral to the true Lemurs, but that they developed parallel with the latter.

Mivart, in discussing the relations of the Lemurs to the Ungulates, came to the conclusion, that merely on account of the similar structure of the placenta in these two groups, as a result, they cannot be considered as closely related. For we know that in the order *Edentata* there are several well marked types of placentæ, as the zonary of *Orycteropus*, (2) the diffuse *Manis* and the discoidal deciduate of the Armadillos and Sloths. Again, as Balfour remarks, "The presence of zonary placentæ in *Hyrax* and *Elephas* does not necessarily afford any proof of affinity of these types with the Carnivora." He further states that the resemblance between the metadiscoidal placenta of man and of the *Cheiroptera*, *Insectivora* and *Rodentia* is rather physiological than morphological. Balfour considers that, although the placenta is capable of being used to some extent in classification, it does not warrant its being employed except in conjunction with other characters.

In conclusion, from a study of the osteology of the recent and extinct Lemuroidea, I believe that this suborder of the Primates is related genetically to the Apes, that *Tarsius* is a true synthetic type, connecting the Lemuroids with the Anthropoids, finally *Tarsius* shows that both Apes and Lemurs have arisen from a common ancestral form.

Charles Earle.
American Museum of Natural History.

THE PRIMARY SEGMENTATION OF THE BRAIN.

In a recent paper on the 'Segmentation of the Nervous System of *Squalus acanthias*,' Dr. H. V. Neal of Harvard University, entirely sets aside the 'Metameres,' or 'Neural Segments' observed by Locy in the neural folds, as not having any phylogenetic significance whatever. This conclusion is particularly interesting when it is taken into account that Locy claims to have traced these "Neural Segments onward in an unbroken continuity until they become the 'neuromeres' of other observers."

In addition to the above, the chief con-

clusions arrived at by Neal may be briefly summed up as follows: He finds that six neuromeres are included in the cephalic plate at the time of its closure, but states that a seventh neuromere is subsequently added to this number, making seven in all which enter into the formation of the encephalon, in which they are distributed as follows—the first and second form the fore- and mid-brains respectively, the remaining five (three to seven inclusive) the hind brain.

The evidence which he advances as to the metameric value of the hind brain neuromeres concerns their correspondence with somites (Van Wijhe's somites, 2-6 inclusive), motor nerves and visceral arches. This correspondence he finds complete for all the hind-brain neuromeres, with the exception of the fourth, which however on hypothetical grounds he regards as possessing a metameric value equivelant to the others, and thus concludes "that these five hind-brain neuromeres are good criteria of the number of primitive segments in this region of the head."

The first two neuromeres (I. and II.) he regards as morphologically equivalent to the hind brain neuromeres, and considers that the absence of a motor nerve in the first is correlated with the loss of musculature of that segment, while the relation of a ventral motor root, the occulomotorius, and Van Wijhe's first somite to the second neuromere (mid-brain expansion), justifies the opinion that these structures are components of a single metamere only.

So far as can be seen by the writer, Neal's conclusions add little to our previous knowledge of the hind-brain neuromeres. One fact, however, in connection with his conclusions which is most gratifying, is that they confirm, wholly or in part, the observations of former investigators, a circumstance which he has apparently overlooked.

C. F. W. MCCLURE.

PRINCETON UNIVERSITY.

CHARLES E. BENDIRE.

MAJOR CHARLES E. BENDIRE, U. S. A., Honorary Curator of the Department of Oology in the U. S. Natural Museum, died at Jacksonville, Florida, February 4, 1897, of Bright's disease. Weary of confinement indoors he went to Florida in hope of finding a milder climate where he might sit outside to enjoy the fresh air and watch the trees and birds—a hope that was not realized, for he died five days after leaving Washington.

Major Bendire was born in Hesse Darmstadt, Germany, April 27, 1836. He was a relative of Weyprecht and Payer, the Austrian Arctic explorers who discovered and named Franz Josef Land.

He came to this country in 1852, and in June, 1854, enlisted as a private in Company D of the 1st Dragoons, U. S. Army. During the next 10 years he was promoted to Sergeant, and served as Hospital Steward in the 4th Cavalry. In 1864 he was transferred to the 1st Cavalry and promoted to 2d, and soon after to 1st Lieutenant. In February, 1873, he attained the rank of Captain, and in April, 1886, was retired on account of an injury to the knee. In February, 1890, he was breveted Major for gallant services rendered on September 13, 1877, in fighting the Indians at Cañon Creek, Montana—an illustration of the subsequentness of glory in the army!

During his long period of service as an army officer he was stationed at a number of the most remote and inaccessible posts in the West, among which may be mentioned Cantonment Burgwyn, in New Mexico; Forts Bowie, McDowell, Wallen, Lowell and Whipple, in Arizona; Bidwell and Independence (the latter in Owens Valley), in California; Harney and Klamath, in Oregon; Vancouver and Walla Walla, in Washington; Boise and Lapwai, in Idaho, and Custer, in Montana. And it should be remembered that his service at most of these

posts antedated the construction of the transcontinental railroads which now traverse the States and Territories in which most of them are located.

Bendire was a man of energy, perseverance and courage, and in our Indian wars naturally took a prominent part. This part was sometimes that of a dreaded foe who followed them relentlessly over mountain and desert and penetrated their most distant retreats; sometimes that of a peacemaker, as when in the midst of the bloody Apache war he boldly visited the camp of Cochise, the celebrated Apache chief, and induced him to abandon the war path. He treated the Indians, as he did everyone else, with perfect frankness and fairness, and never deceived them. They were not long in learning that they could rely absolutely on his word, which gave him a positive advantage in all his dealings with them, for they always respected him and when not at war liked him.

Aside from his movements in the field in connection with Indian wars, he led a number of expeditions for other purposes, such as laying out roads, surveying routes for telegraph lines, and exploring unknown country—as when he crossed Death Valley in 1867, and explored the deserts of south-central Nevada as far east as Pahranagat Valley. No other American naturalist in modern times has spent half so much time in the field as Bendire, and his voluminous note books attest the accuracy and range of his observations.

It is hard to say just when Bendire's scientific work began, or even exactly when he commenced making his famous collection of birds' eggs, though it is certain that he was collecting in 1870. Like many other army officers stationed in the West, he sent Professor Baird from time to time natural history specimens and notes. When stationed at St. Louis he became an intimate friend of the eminent botanist, Dr. George Engelmann, to whose herbarium he was a valued contributor.

His earliest published writings are in the form of letters to well-known naturalists, chiefly Allen, Baird and Brewer. The first volume of the Bulletin of the Nuttall Ornithological Club (1876) contains several such letters, published by J. A. Allen.

In 1877 he published an important paper on the Birds of Southeastern Oregon, based on three years' field work in the region around Fort Harney. In all, he has written about fifty papers, most of which relate to birds and their eggs, though several treat of mammals and fishes. But the work which will carry his name and fame to future generations is his 'Life Histories of North American Birds,' of which the second volume was reviewed in SCIENCE not long ago (N. S. Vol. IV, No. 96, October 30, 1896, pp. 657-658). It is a calamity to the science of ornithology, for which he was in no way responsible, that the remaining volumes of this great work, which contains more original information on the habits of our birds than any other since the time of Audubon, Wilson and Nuttall, were not made ready for publication.

In his personal life Bendire was a man of simple habits and unusual frankness. He had an inborn aversion for all kinds of circumlocution and insincerity, and was himself a model of directness and truthfulness. He was generous, kind hearted and ever ready to help others, no matter at how much personal inconvenience, if he believed them worthy. He had a large number of correspondents in all parts of the country who considered it a privilege to contribute notes and specimens for his use. These and many others will mourn his loss, but none so deeply as the small coterie who were so fortunate as to be numbered among his intimate personal friends.

C. HART MERRIAM.

CURRENT NOTES ON PHYSIOGRAPHY.

NORTHWESTERN OREGON.

A GEOLOGICAL reconnoissance in northwestern Oregon by J. S. Diller (17th Ann. Rep. U. S. Geol. Survey, 1896, 1–80) gives new examples of mountains resulting from the dissection of peneplains. The Coast range in this district, consisting of inclined Miocene and older formations, shows uplands, bevelled across the tilted strata in gently sloping plains at various altitudes, as if the product of erosion at successive levels. A number of small monadnocks rise above the upper plain, and the narrow valleys of the streams are incised beneath the lowest. The relations of the different peneplains are not fully worked out. During the lower stand of the region, when the peneplanation was accomplished, Willamette valley of to-day was a drowned valley, like the existing Puget sound; and it is now floored with the sediments of that submergence. The sediments contain ice-rafted boulders, thought to be derived from the glaciers of the neighboring Cascade range on the east, then more extensive than now, in spite of the lower stand of the land. During emergence two of the stronger rivers seem to have maintained transverse courses across the rising peneplain (the Coast range), so that they now gather headwaters in Willamette valley. Old sea cliffs and beaches at various levels on the western slope of the Coast range record pauses during emergence; similar pauses are indicated by terraces along the river valleys. The movement of elevation continued until a five-mile belt of the existing sea bottom was added to the land; the evidence of this being found in the extension of river channels seaward from their present mouths, as determined by Coast Survey soundings under Davidson. Subsidence to the present altitude has drowned the rivers a number of miles up stream, letting the tide far inland. The present shore line is sub-mature; alternating between bold rocky headlands not yet cut back to a graded outline, and long, smoothly curved beaches of concave outline towards the sea.

GLACIAL DEPOSITS OF INDIANA.

UNDER the above title, Frank Leverett, who has for some years past carried on field studies of the drift under the direction of Professor Chamberlain, gives a summary of his results for a central state (*Inland Educator*, August, 1896, 24–32); the essay being one of a series designed by Professor Chas. Dryer, of the State Normal School at Terre Haute, for the edification of local teachers. Leverett states that the border of the drift, as indicated on his outline map, needs correction, for repeated observations have convinced him that it extends further southward than is indicated on Wright's map of the glacial boundary (Bull. 58, U. S. Geol. Surv.). The succession of glacial deposits and associated loess beds, with interglacial soils, is briefly described and the chief moraines are mapped. The terminal moraine of the Wisconsin (third) stage of glaciation is a broad ridge generally twenty feet high. Within the space of half a dozen steps one may pass from loess-covered tracts of earlier drift to the bouldery drift of this later invasion. There is an accompanying change of soil color and composition, from ashy (loess) to black (drift), of a great agricultural importance. Certain prominent moraines near the western boundary (Benton and Warren counties) are overridden by transverse or unconformable bouldery moraines. A temporary lake, apparently enclosed by ice on the east and north, explains the sands spread over the northwestern counties.

If the geographical aspects of the drift, both as to form and occupation, could be more fully stated by Mr. Leverett in another article, better work by local teachers would be still further promoted.

SCIENTIFIC GEOGRAPHY IN ITALY.

An encouraging sign of progress in geographical instruction is found in a note on the Scientific Systematization of the Study of Military Geography, by Lieut.-Col. C. Porro (Rev. Mil. Ital., 1896, 30 p.). After reviewing the various methods of geographical study for some time back, he adopts the guidance of Lapparent in emphasizing the importance of a rational understanding of the origin of topographic forms as a means of better perceiving the forms themselves, and urges such study as a basis of specialization in military geography. The Italians already being well advanced in the production of elaborate maps and reliefs, they are prepared to profit greatly by exchanging the earlier empirical methods for more modern scientific and systematic study. Geomorphology, as recognized in this country, has hitherto had no place in Italy, in spite of the beautiful variety of topographic forms on which its methods might be exercised.

NOTES ON ASHANTI.

Major C. Barter gives some Notes on Ashanti, taken while on the (British) Ashanti expedition of 1896 (Scott, Geogr. Mag., xii., 1898, 441–458). He says, in his preface, that the most he could offer, outside the military features of the campaign, would be a record of general impressions and of local accounts and traditions which his memory had retained. His interesting narrative is largely concerned with other than physiographic matters. Landing in surf boats, a fatiguing march followed across twenty miles of sandy undulating country, covered with low bushes, gradually merging in the primeval forest, of which an impressive description is given. The forest belt is about 300 miles broad, and beyond its northern border, which limits Ashanti, come rich prairie plains, with healty climate and an abundance of big game, under the Sultan Samory. The forest country is undulating, except in isolated hilly districts of small area; the water courses are broad and swampy. The clearings about villages are connectad by paths, on which from one to four men can walk abreast. The excessive dampness is relieved by the Harmattan, or 'Doctor,' a steady cool breeze which blows from a northerly direction during the winter months, apparently a local manifestation of the normal northeast trade.

This note is offered not so much for its physiographic value as for a sample of the gleanings that may be gathered from the usual observations of the military explorer. If British military training were based on the recommendations of Porro, above, the geographical harvest of foreign expeditions would be richer; but those in charge of the program of British military schools might plausibly say that they are so well satisfied with the success thus far attendant on their graduates that they find no reason for altering their curriculum.

W. M. Davis.
Harvard University.

CURRENT NOTES ON METEOROLOGY.

CLOUD HEIGHTS.

In a recent number of *Nature* (Dec. 31) Clayton makes some important suggestions concerning possible errors in calculating the heights of certain forms of clouds by means of theodolites and photogrammeters. At Blue Hill Observatory the average height of nimbus obtained by theodolite measurements is 6,814 feet, while the height of the base of the same kind of cloud as shown by sending kites into it is usually less than 1,640 feet. There is seen to be a considerable discrepancy here. Evidently the kite measurements are the most accurate, and there can be no doubt that the nimbus cloud belongs lower down in the cloud classification than the position it now occupies in the International Nomenclature, as given in the new Cloud Atlas. In the

Atlas the nimbus and the strato-cumulus are placed together under the heading *Lower Clouds*, and their average height is given as about 6,600 feet, or considerably over a mile, while the Blue Hill measurements make the height of the nimbus less than half a mile. The more the future of kite meteorology is considered, the more numerous do the opportunities seem to become in which kites will be of great service. This measurement of cloud heights by means of kites is certainly one of the most important uses to which they have yet been put.

FOG POSSIBILITIES.

IN a short article under the title *Fog Possibilities*, in Harper's Monthly Magazine for January, McAdie regards it as a possibility of the future that fogs will be dispelled by artificial means. Lodge has shown by his experiments that the dust in the air, which is of such importance in fog and cloud formation, can be removed by electrification. The fog may be dissipated by gentle electrification, which increases the size of the dust particles until they settle, or by strong electrical discharges, which scatter and precipitate the particles. McAdie believes that "fog dispellers might be placed upon war ships, ferry boats and at all terminal depots and crowded thoroughfares." "We cart away," he says, "from our busiest streets the snow or solidified vapor of the air. Is it not better economy to attempt the conquest of the water vapor in another form?"

INTERNATIONAL BALLOON METEOROLOGY.

COMMENTING on the subject of balloon meteorology, M. de Fonvielle, in a recent letter to the editor of SCIENCE, says: "It should be deeply regretted if your great nation should not join in these experiments, which are executed in a friendly spirit by three fractions of the European family which are not always in harmony on the surface of the earth. * * * One important fact seems to result from all the experiments tried in France. When the balloon reaches a high altitude, 30,000 feet, at least, it is sure to be discovered in some locality eastward from the Paris meridian. This observation, which is * * sufficiently well established, gives a warning against the execution of these experiments from the eastern coast of the Atlantic. Neither New York, Philadelphia nor Washington are to be selected as a proper starting point. St. Louis should be eligible and a lot of other cities. The same might be said of any place west of the Rocky Mountains, especially of any place selected in California, as the Mt. Hamilton Observatory."

R. DEC. WARD.

HARVARD UNIVERSITY.

CURRENT NOTES ON ANTHROPOLOGY.

THE SHELL GORGETS OF NORTH AMERICA.

THE study of this interesting class of antiquities is aided by the description of one from Mexico by Professor Frederick Starr in the 'Proceedings' of the Davenport Academy, Vol. VI. It was found in the State of Michoacan, and a cut of it is inserted. Many points of similarity are noted between it and those from Tennessee, Georgia and Missouri, described by Holmes and Thruston. These are sufficient, in Professor Starr's opinion, to affiliate the Mexican example to those of the Mississippi Valley as members of one and the same art-development.

The possibility that these objects might have been carried as articles of trade from one region to another is considerable. The finding of one or several in a spot does not of necessity infer the identity of culture. The motives are Aztecan, but, unless supported by other indications of that peculiar school of design, it is more likely they were 'intrusive' objects.

THE RED RACE OF MADAGASCAR.

It is a curious fact that the older navigators who visited Madagascar describe a red race there, which now seems to be extinct. In the 'Bull. de la Soc. d'Anthropologie,' of Paris (Tome VII., fasc. 5), Dr. Bloch collects a number of extracts bearing upon this. The red people are described as tall, without beards, nose prominent, hair straight and long, the features of the European rather than Mongolian type, and the color of the skin red or reddish. This race, the description of which corresponds singularly with that of the North American Indian of the Algonquian or Iroquoian stock, appears to have passed out of existence about the middle of the last century. It is to be hoped that at least some ancient cemeteries may supply their osseous remains. One writer, Flacourt, believes them to have been the ancestors of the Hovas, but the physical traits do not correspond.

GLACIAL MAN IN OHIO.

Especial interest attaches to an article in the *American Geologist* for November, 1896, by Professor E. W. Claypole, on 'Human Relics in the Drift of Ohio.'

It is principally taken up with the description of a polished slate axe disinterred in 1886 from the bottom of a well, 22 feet deep, near New London, Ohio. It was neatly and symmetrically carved, and deeply weathered. The stratum was a late glacial deposit, lying directly upon the boulder clay.

Professor Claypole used all practicable precautions in examining the well digger who found the specimen (ten years before), and in confirming his statements. He presents the evidences of authenticity with as much conclusiveness as they will bear; and he meets the various objections which will arise from the length of time, from the artistic finish of the specimen and from the veracity of the witness. His article is excellently studied, and if it fails to convince, it will be from the weakness of the case, not from deficiencies in presenting it.

D. G. Brinton.
University of Pennsylvania.

NOTES ON INORGANIC CHEMISTRY.

The question as to whether illuminating gas or fuel gas is completely consumed in an ordinary burner possesses a considerable interest, not only from an economic, but also from a hygienic standpoint, since even small quantities of carbonic oxid are dangerous to health. Investigations have shown that in free burning flames, as well as in the Welsbach burner, practically no unconsumed gas is given off, but doubt has been thrown by the experiments of Vivian B. Lewes on flames which impinge on cold surfaces, as in gas stoves for cooking and under water baths in the laboratory. This point has been carefully studied at the Technische Hochschule at Karlsruhe by F. Haber and A. Weber, and their results show that with a sufficient supply of air, even under cold surfaces, the gas is completely burned, but if the air supply is insufficient decided quantities of carbonic oxid may be formed. Thus with the laboratory Bunsen no danger is to be apprehended, but with gas stoves care is necessary to see that there is a plentiful air supply.

In continuing his work upon metallic lithium M. Guntz finds that it has a strong affinity for carbon, forming a carbid Li_2C_2, which is decomposed by water with the formation of acetylene. When lithium is heated in contact with carbon it unites with it directly. When compounds which give lithium by dissociation, as lithium hydrid or lithium nitrid, are heated with carbon, the carbid is formed, in the latter case accompanied by large quantities of lithium cyanid. Carbonic oxid and carbon dioxid

are both absorbed by lithium with formation of the carbid. Heated in an atmosphere of acetylene or of ethylene, the gas is completely absorbed and a definite mixture of lithium carbid and lithium hydrid formed. Lithium seems, however, to be almost without action upon methane.

M. PETIT has carried out a series of experiments at the University of Nancy on the action of waters containing dissolved salts upon iron. He was led to the work by the fact that the waters of the Moselle (and the same is true of many other waters) attack iron pipes and reservoirs, often penetrating them, while large quantities of iron oxid are deposited. The action is due, he finds, chiefly to the action of carbonic acid, free or in the state of combination in calcium bicarbonate. Such water rapidly attacks the iron with liberation of hydrogen. The iron is at first present in solution as ferrous carbonate, but is rapidly oxidized by dissolved oxygen and deposited as ferric oxid. If other salts are present the action is increased. Thus alkaline sulfates are reduced by the iron to alkaline sulfids, and these are changed by the carbonic acid to alkaline carbonates, while the liberated sulfur forms, with the iron, ferrous sulfid. Common salt acts most energetically, here also sodium bicarbonate being formed. This action of iron upon calcium bicarbonate and on carbonic acid explains the action of such waters on iron pipes, and also the purification of water by spongy iron.

The action of certain hard waters on brass (faucets, etc.), may possibly be similarly explained, the carbonic acid acting upon the zinc and leaving the brass in an almost porous condition. J. L. H.

SCIENTIFIC NOTES AND NEWS.

A DIRECTOR OF SCIENTIFIC WORK FOR THE DEPARTMENT OF AGRICULTURE.

THE Secretary of Agriculture, in his fourth annual report to the President, calls special attention to the benefit that has resulted from the use of the classified civil service in the Department, and urges that this system should be completed by the appointment of a permanent director of scientific work. We have already urged this step, but it may be well to repeat the arguments of the Secretary of Agriculture.

The Secretary, being a Cabinet officer, must be changed with each new administration, and the Assistant Secretary is subject to the same conditions. These executive officers are necessary, but another officer is needed to direct the work of the various scientific bureaus of the Department, under the general authority of the Secretary, and to give permanence to the policy of the Department. In order to accomplish the best results, the Department must have a settled policy with regard to all its scientific work. This Department has less relation to the general executive business of the government, and less connection with what is usually called politics, than any other Department of the government. In fact, the scientific work of the great bureaus, divisions and surveys should be kept free from politics to be efficient and impartial. The numerous bureaus and divisions do not have under the present organization, in fact cannot have, the attention and direction which the interests involved demand. After a change of administration the Department is practically headless, and to a great extent helpless, until the new Secretaries have had time to master the details of the technical work. A director of scientific divisions is needed, therefore, if for nothing else, to carry on the scientific work of the Department from one administration to the next. Further, the Secretary of Agriculture cannot be expected in all cases to unite the necessary executive ability with adequate scientific training, and his duties are already onerous, a large part of the work of the Department extending over the whole country.

The Senate Committee on Agriculture and Forestry last year recommended the passage of the bill establishing the office of 'Director in charge of scientific bureaus and investigations for the Department of Agriculture,' but the bill was introduced too late for consideration dur-

ing the last session of Congress. The estimates for the next fiscal year contain, however, a recommendation for an appropriation of $6,000 per annum for this office, in the expectation that it will be created by Congress.

YOUNG'S 'REVERSING LAYER.'

In a careful review of the progress of astronomy during the year 1896, published in the London *Times* of January 14th, the author writes: "At Novaya Zemlya, Mr. Shackelton, using a spectroscope without a slit—since the extremely narrow sickle of light at the moon's limb made a slit unnecessary—and timing the exposure of his plate to the precise moment of the progressing eclipse which corresponded to that at which Professor Young made his classical observation by eye in 1870, was fortunate enough, with an exposure of half a second, to secure a permanent record of Young's reversing layer. It consists of a very narrow spectrum of bright lines, which are, indeed, the Fraunhofer lines reversed. A plate exposed two seconds later showed a comparatively simple chromosphere spectrum. The congratulations of astronomers are due to Professor Young upon this complete, though late, confirmation of his observation of 1870 and of his views, speaking broadly, of solar absorption founded upon it. Professor Young, after a careful comparison of the Novaya Zemlya photograph with a Fraunhofer spectrum taken with the same prisms, but with a collimator and slit before the prisms, writes:

"'With very few exceptions every Fraunhofer line finds its correlative in the 'flash spectrum.' I do not see but that the evidence as to the origin of the great majority of the Fraunhofer lines within a very short distance from the photosphere is practically complete. Very possibly some of the absorption occurs at higher levels; but it seems to me clear that most of the absorbing metallic vapours are at the base of the chromosphere, in a thin stratum or layer, if one chooses to call it so; not that I suppose it to be a quiescent sheet or a stratum in any different sense from the chromosphere itself.'

"Professor Young further points out that it would be absurd to compare the number of bright lines of this 'flash' spectrum, taken with two prisms only, a lens of 10-in. focus and no slit, with the number of dark lines in Rowland's great solar map, photographed with a large concave grating, a fine slit, and every possible refinement of adjustment."

MOTOR CARRIAGES.

In view of the scientific and practical importance of motor carriages, we give the report made by the jurors in connection with the recent exhibition at the Crystal Palace, London:

"Although none of the vehicles exhibited approached that degree of perfection which would place them beyond the adverse criticism which condemns any evidence of an unrealized attempt, they are of opinion that several of the vehicles shown and worked in the Crystal Palace grounds have reached a degree of practical sufficiency meriting some distinctive mark of appreciation. Most of the vehicles, which have withstood the test of considerably hard daily work, were propelled by motors actuated by the internal combustion of light oils, such as benzoline. The use of these light oils in this country has been discouraged, although the cause of this is probably due more to fiscal and to other restrictive regulations than to any real evidence of danger attaching to it. Most of the carriages exhibited and worked in the grounds have motors supplied with hydrocarbon vapor, produced by the passage of air through some form of carburetter containing benzoline. This vapor, mixed with air, and compressed and heated by the incoming stroke of the motor piston, was, with one exception, ignited by an electric spark, obtained by means of a secondary battery and induction coil. The one exception was the carriage of Peugeot, fitted with a Daimler motor, and lent by Sir David Salomons. This vehicle, however, did not come within our cognizance at the time of our visit with respect to the merits and awards.

"We have carefully considered the various points in the construction, detail and working of the several vehicles and their motors, and we are very strongly of opinion that these benzoline motor carriages do, even in their present state of advance towards sufficiency, show that such motors may be practically employed for propelling vehicles of various kinds and for various purposes. The carriage of M. Delahaye showed a distinct step in advance upon the

other benzoline motor-vehicles; its double small horizontal cylinders, with opposite cranks and other details, including a very satisfactory tubular water cooler, with simple force pump circulator, secures steadier motion, freedom from escaping steam or water vapor, and more power in a given space. He has placed before us a carriage which only needs the development to which experience will point the way.

"These latter remarks pertain equally with regard to the steam vehicles exhibited and worked. The steam vehicles undoubtedly showed the greatest power and the greatest flexibility or range of power. The ability to stop the motor and start without manual assistance was seen to be a noteworthy advantage, not only as a matter of convenience, but as a means of avoiding an otherwise very persistent vibration of the vehicle when standing. The steam carriage exhibited by M. Serpollet, although not of the maker's most recent form, is one which merits particular notice for its originality, its value as an indication of the possibilities with a steam boiler and engine of the types used, its superiority with regard to range of power, and its exemplification of the advantages already referred to as to convenience in several respects.

"The steam van exhibited by the Thornycroft Steam Carriage and Wagon Company we also recognize as a very meritorious illustration of the most useful lines upon which arrangement and development of a most important class of motor-vehicles may proceed. The jurors considered it matter for regret that no electrically propelled vehicle had been submitted for trial."

GENERAL.

HON. JAMES WILSON, of Iowa, will be Secretary of Agriculture under the next administration. He is director of the Iowa Agricultural Station and professor of agriculture in the Iowa Agricultural College. He was for many years a teacher in the country schools and has been since a practical farmer, having earned the money for the purchase of the farm of 1,200 acres, said to be one of the best equipped and best managed in the State, which he now cultivates. Professor Wilson has served three terms in Congress. He was born August 16, 1835, in Ayrshire, Scotland.

IT is reported that Judge Joseph McKenna, of California, will be the next Secretary of the Interior.

THE St. Petersburg Academy of Science has elected M. Joseph Bertrand, the permanent secretary of the Paris Academy of Sciences, an honorary member.

PROFESSOR E. E. BARNARD, of the Yerkes Observatory, University of Chicago, has sailed from New York for Southampton, on his way to London. He will attend the meeting of the Royal Astronomical Society on February 12th, to receive the gold medal awarded to him for distinguished service to the cause of astronomical science.

A SANITARY conference on the Bubonic Plague opens at Venice to-day. The representatives of Great Britain will not favor quarantine regulations, but the Continental governments seem apprehensive lest the plague may spread to Europe. Dr. Koch has been summoned by the German government from South Africa, where he has been studying the rinderpest, to head a special commission which will be sent to Bombay to investigate the plague and report on measures that should be taken to prevent its introduction into Europe. Similar steps are being taken by the governments of Russia and of Italy. The plague has not appeared in eastern Europe since 1721 and not in England since 1665, when upwards of 100,000 persons died from the disease. The Black Death of the fourteenth century, which in three years destroyed 24,000,000 Europeans, was perhaps the bubonic plague. The plague is essentially a *miseriæ morbus* and the present sanitary conditions are such as to make an epidemic unlikely. Still a man who is so little an alarmist as Lord Lister said in a recent address in Belfast that the plague might be easily carried from Bombay in ships. "Rats were liable to contract it, and a rat making its escape from a ship coming from Bombay—say, to the Thames or to Belfast Lough—might carry the plague ashore and, entering any of their slums, might affect human beings with this dreadful disease."

MT. ACONCAGUA, in the Andes, over 24,000

feet in height, has been ascended by the Swiss guide, Zurbriggen. He was in the company of Mr. Fitzgerald, who was unable to reach the summit.

At the International Exhibition at Brussels in 1897 special efforts will be made to secure an adequate representation of the sciences. Space for scientific exhibits will be given free of charge and a considerable number of prizes are offered.

The King of Belgium has offered a prize of about $5,000 for an essay on the sanitary conditions of equatorial Africa. Papers for competition should be presented by July 1st of the present year.

A public library and museum will be founded at Cettigne, Montenegro. The antiquities found in the principality itself will be deposited in the museum. The excavations recently made at Dukla have produced satisfactory results.

We regret to record the deaths of Baron von Ettingshausen, professor of botany at the University of Gratz, at the age of 71 years; of Dr. Edward Ballard, F. R. S., the author of works on public health and other medical subjects, aged 66; of M. Martini, the inventor of the Martini rifle; of Dr. Wilhelm Deeke, the German archæologist, at the age of 66; of Kristian Bahnson, the Danish ethnologist; of Joseph D. Weeks, editor of the *American Manufacturer*, at Pittsburg, Pa., and known for his contributions to economic geology; and of Giuseppe Protonotari.

According to *Nature*, the scientific expedition organized by the German government to study the economic and industrial conditions and possibilities in the Far East intended to start from Bremen on January 27th, on board the North German Lloyd steamer *Sachsen*. The nature and scope of the investigations to be undertaken were discussed and settled at a recent meeting at the Ministry of the Interior.

Natural Science, quoting from the *Daily News*, reports that the Imperial Natural History Society of St. Petersburg, intends to publish a Flora, first of European Russia and afterwards of Russia in Asia and the Caucasus.

Senator Gallinger has presented, by request, in the Senate, a bill for a department of health proposed by the Pan-American Medical Congress.

A bill introduced into the Wisconsin Legislature provides for a State bee inspector to suppress foul brood among bees. The wholesale valuation of the honey and beeswax produced annually in Wisconsin is $160,000.

At a meeting of the Fellows of the Royal Botanical Society, on January 30th, it was agreed that the use of the gardens should be offered to the Lord Mayor, the Chairmen of the London County Council and the London School Board, and the secretaries of societies desirous of holding receptions.

Mr. Macartney stated recently in the British House of Commons that the question of the unification of time, which is a very debatable one, has received long and careful consideration for many years. The alteration of the astronomical day cannot be effected for the sea alone, as it affects astronomers even more closely than sailors, and it must also be carried out by international agreement. Foreign powers publishing astronomical ephemerides were consulted in 1894, and when it was found, from the replies received in 1895, that the change would not be accepted by all these the Foreign Office was requested to inform the powers in question that no further steps would be taken by the British Admiralty. The Nautical Almanac for 1901 has therefore been calculated on the existing system.

An Italian Electro-technical Society has been formed in Milan, with Professor G. Ferraris, of Turin, as its first president.

Mr. Uriah A. Boyden, of Boston, has offered, through the Franklin Institute of Philadelphia, a prize of $1,000 to 'any resident of North America—including Mexico and the West Indies—who shall determine by experiment whether all rays are or are not transmitted with the same velocity.' The papers must be submitted before January 1, 1898.

We learn from *Nature* that the University of Catana has been presented with the Island of Cyclops, off the coast of Sicily, by Signor Gravina. The island is only a kilometer in circumference, but its configuration is peculiar, and the center is about one hundred meters

above sea level. It is proposed to construct upon the island a laboratory for investigations in zoology and pisciculture.

THE Boston Society of Medical Sciences has begun the publication of a journal, which is issued, for the present, for free distribution. It contains authors' abstracts of papers presented at the meetings of the Society, and is published promptly after each meeting. A vote of the faculty of the Harvard Medical School requests 'each head of department to have, at least, a summary of the scientific investigations made in his department presented at a meeting of the Boston Society of Medical Sciences for preservation in its journal,' so that the journal will contain a summary of what work of this nature is done in this school. Similar action has been taken by the biological and physiological departments of the Massachusetts Institute of Technology, and contributions of the same nature are promised from Clark University and from the experimental laboratories of the Massachusetts General and the Boston City Hospitals. Papers, or abstracts of papers, upon subjects connected with the medical sciences will be welcomed from persons who are not members, and, if approved by the Council, will be presented at these meetings, and abstracts will be given a place in the Journal of the Society. All communications should be addressed to the Secretary of the Boston Society of Medical Sciences, Harvard Medical School Boston, Mass.

THE general dissatisfaction with the position of geography in secondary schools, and the strong efforts made on every hand for its improvement, are the justification of adding one more to the list of educational journals; the *Journal of School Geography* having just made its appearance. Professor R. E. Dodge, of the Teachers' College, New York, is the responsible editor, with five associate editors, Messrs. Davis, Hayes, Kümmel, McMurry and Ward. The first number contains an introductory statement by the editor; Home Geography, by W. M. Davis; Some Things about Africa, by C. C. Adams; Geographic Instruction in Germany, by Will S. Monroe; Suggestions Regarding Geography in Grade Schools, by R. E. Dodge, and a variety of notes and reviews. Readers of SCIENCE, as possible writers for this journal, should address the editor, Teachers' College, 120th St. West, New York City; as subscribers, they should send a dollar for ten yearly numbers to the publishers, 41 N. Queen St., Lancaster, Pa.

THE lecture on Variation of Latitude, by Professor J. K. Rees, before the New York Academy of Sciences, April 29, 1895, has been reprinted by the Smithsonian Institution from the report in SCIENCE, New Series, Vol. I., No. 21. The paper is made part of the Smithsonian Report for 1894, pp. 271–279, and is also printed as a separate pamphlet.

Nature states that following the example of the Institution of Civil Engineers, the Society of Civil Engineers of France has built itself a magnificent house, which was opened with great ceremony, on January 14th, by the President of the French Republic. A large number of guests were present at the soirée, including representatives of the various French technical societies. The only English society represented was the Iron and Steel Institute, who sent Professor Roberts-Austen. The new building, which is situated in the Rue Blanche, Paris, was designed by M. F. Delmas, and was erected in 262 days. It comprises in the basement engine-rooms and store-rooms, on the ground floor the meeting-room, on the first floor reception-rooms for the members, on the second floor the secretary's office and the council-room, and on the third floor the library. Access to the various floors is obtained by means of an electric lift. The meeting-room contains seats for 500 persons, and the floor is so arranged that it may be horizontal for receptions, or inclined so as to convert the room into an amphitheatre for the meetings. The floor weighs thirty tons, and its transformation from a horizontal to an inclined position is effected with great rapidity by means of hydraulic machinery.

Natural Science reports that the Committee of the International Geographical Congress, held in London in 1895, has recently sent to the various geographical societies, resolutions, urging the importance and desirability of: (1) Antarctic exploration; (2) a geographical bibliog-

raphy, compiled by various states; (3) a topographical survey of Africa; (4) a map of the earth on a scale of 1:1,000,000, with the meridian of Greenwich and metric measurements; (5) the continuance of physical investigations lately made in the Baltic, North Sea and North Atlantic; (6) an international system of seismographic stations; (7) agreement between the various geographical societies at to the spelling of foreign names; (8) the printing on all geographical maps henceforward the date of their publication. Further, they request the opinion of the societies as to the application of the decimal system to the measurement of time and of angles.

A CORONER'S jury at Jamestown, N. Y., has rendered a verdict to the effect that Spurgeon Young came to his death on January 24th from diabetes and nervous exhaustion caused by hypnotic practices performed by persons who are specified. It is said to be probable that the matter will be carried to the courts.

ACCORDING to the *British Medical Journal*, M. Julien Dumas has announced his intention to interrogate the French government on the abuse of the Bertillon system of measurement. M. Dumas asserts that the calculations made by M. Bertillon are far from correct. He has had in his possession measurements taken of the same person at an interval of ten years. There were not two alike. M. Dumas expressed his desire to visit the anthropometric service. The Minister of the Interior and the Police Prefect asked him to name his day. M. Bertillon, with great courtesy, explained his system. He sent for a woman who had refused to give her name. She then said her name was Garcias, her birthplace Bordeaux. Measurements were taken. M. Dumas, being initiated, found without assistance the photograph of this woman, whose real name was Tosas, and her birthplace was not Bordeaux. Much astonished he warmly praised anthropometry. He carried away with him four or five books on the subject. In one of them he found three photographs typical of the criminals most often met with. One of these was of the woman measured that morning, kept on the premises, according to M. Dumas, to illustrate the system.

THE Russian National Health Society has celebrated, in the manner proposed, the Jenner Centenary. Addresses were made by the Grand Duke Paul, Dr. Kudrin and Dr. Cormillo. Gold medals for the best works on vaccination were awarded to Dr. Layer, of Bordeaux; Dr. Miller, of Moscow, and Dr. Glagolef. The exhibition in connection with the celebration is said to be very full and interesting.

THE Baroness de Hirsch has given $300,000 to found a hospital on the Mediterranean coast for English consumptive children.

THE *Botanical Gazette* states that $6,000 has been appropriated for the erection of a research laboratory at Buitenzorg.

IT is stated in the *British Medical Journal* that the Society of Neurologists and Psychologists of Moscow has appointed a special committee (1) to report upon the present state of inebriety in that city, and (2) to draw up a scheme for the erection of a hospital for inebriates.

THE Secretary of Agriculture, in his report to the President, calls attention to the fact that during the fiscal year just ended the exported products of American farms aggregated a value of $570,000,000. That is a gain of $17,000,000 over the preceding year. During the fiscal year 1896 agricultural products make up only 66 per cent. of the total exports of the United States, as against 70 per cent. in 1895, 72 per cent. in 1894, and 74 per cent. in 1893. But the reason of a relatively decreased value of 4 per cent., with an increase in the absolute valuation of agricultural products shipped in the year 1896, amounting to $17,000,000 more than those of the preceding year, 1895, is solely due to the unprecedented sale abroad of American manufactured goods and commodities, the exports of which from the United States jumped from a valuation of $184,000,000 in 1895 to $228,000,000 in 1896.

THE *Lancet* states that, at a recent meeting of the Plymouth Borough Council, the question of the acquisition of Dartmoor by the County of Devon, in order to prevent further encroachments, was discussed. This scheme, which was submitted by the Dartmoor Preservation Association, was unanimously ap-

proved of, and the Council pledged itself to bear its fair share of the cost of purchasing 130,000 acres of Dartmoor from the Duchy of Cornwall, provided that the county authorities have power to preserve all objects of archæological and antiquarian interest and the indigenous plants and animals. The other Devonshire authorities have also promised their support to the scheme.

THE correspondent of the *British Medical Journal* at the Cape of Good Hope writes that Professor Koch joined Dr. Edington, the bacteriologist, to Cape Colony, early in December, and that a number of *post-mortem* examinations of animals were made by them together. In the beginning of October, when the disease had passed well within the lines of railway so as to be easily accessible, Dr. Edington converted a saloon car to serve as a laboratory, and went with a veterinary assistant, Mr. W. Robertson, and his secretary, Mr. Guthrie, to the infected area. Some difficulty was at first experienced in getting the assistance of the chief of the Kaffirs there, but eventually, with the assistance of some Fingoes, a camp was established, and bacteriological and pathological investigations were begun. It was at this camp that Professor Koch studied the *post-mortem* appearances, and the virus obtained from these animals is now being investigated at Kimberley in a laboratory which has been just set up by the bacteriological department, and it is probable that Dr. Koch and Dr. Edington will shortly work there together. The inoculation experiments with blood made at the camp by Dr. Edington and his assistants showed that a rise of temperature was thus produced usually after about four days, but not always, as the rise was sometimes delayed. The blood examined showed the presence, in most cases, of bacillary forms and some irregularly spherical organisms. In some instances scarcely anything was to be seen, but if care were used the bacillary forms could be recognized. A short bacillus about $2\,\mu$ long and $0.5\,\mu$ broad has been isolated, which has been used for inoculation with positive results. As, however, within the past six weeks 20,000 cattle have died in the country in which the rinderpest camp is situated, it is evident that no definite statements can be made until the cultures have been tested in an area free from the disease.

THE following notes on French explorations are taken by *Natural Science* from *Anthropologie*. Mr. Clozel, Administrator of the French Possessions on the Ivory Coast, is endeavoring to make valuable ethnographic and geological collections. Important results are expected from two such enthusiastic explorers as Messrs. Bonnel de Mézières and de Béhagle, who are starting for Central Africa. Mr. Bonin has returned to Tonkin from the south-western provinces of China, whence he brings much material and many facts of an ethnographical and anthropological nature. On their way from Turkestan to Siberia, Mr. Chaffanjon and his party have gathered large collections of the fauna and flora, and accumulated much information regarding ethnography and geography. In Siberia, too, Baron de Baye has been carrying on his archæological and ethnographical studies. Mr. E. Blanc, who has been to Nijni-Novgorod, is bringing back rich scientific collections. Mr. Raoul, Official Colonial Chemist, is starting on government business for Borneo, where he hopes to carry on scientific studies. The Hourst expedition, whose return, which has been already noted, has proved the navigability of the Niger from Bammako to the sea.

ACCORDING to the *London Times*, the Colonial Office, the Natal and Cape governments and the Board of Agriculture have been in communication for the past month as to the best means of preventing the cattle plague in South Africa from spreading into either Natal or the Cape Colony. Various inquiries have been made as to what steps should be taken, and recently at the Board of Agriculture, a special conference of heads of departments concerned was held to consult together on the subject. The chief officials concerned of the Board of Agriculture and the Colonial Office met the Agents-General of Natal and the Cape Colony and other Cape authorities. Further meetings will be held on the subject, and it is contemplated that the government will sanction every effort to save the colonies of Natal and the Cape from rinderpest.

ACCORDING to *Industries*, the Parliamentary

return as to street and road tramways during the year ending June 30, 1896, signed by Mr. Francis J. S. Hopwood, is just issued. It shows that the total capital expended in England and Wales during the year was £11,742,204, as compared with £11,685,355 in the preceding year. The total for the United Kingdom was £15,195,993, against £14,956,343. The length of line open for public traffic in the United Kingdom was 1,009 miles, an increase of 27 miles on the preceding year. While the horses used by the companies increased from 32,273 in 1894-95 to 35,621 in the succeeding year, the number of locomotive engines belonging to the companies decreased by two. The engines numbered 568 in 1895, as compared with 452 in 1896 and only 14 in 1878. The total number of passengers carried on the tramways in the United Kingdom during the year was 759,466,047, against 661,760,461 in the preceding year; the working expenses £3,105,511, against £2,878,490; and the net receipts £1,046,505, against £855,200. There were 37 tramways belonging to local authorities, with a total mileage of 335 as compared with 116 belonging to other than local authorities with a mileage of 673.

THE Annual General Meeting of the Royal Meteorological Society was held on January 20th, Mr. E. Mawley, President, in the chair. The Secretary read the report of the Council, which showed that the Society had made steady progress during the past year, there being an increase of seventeen in the number of Fellows. The President then delivered an address on 'Shade Temperatures,' in which he stated that of all meteorological observations there were none approaching in importance those made of the temperature of the air, generally known as 'Shade Temperature.' Indeed, the first question invariably asked in regard to almost any climate was as to its temperature. Mr. Mawley traced the history of the different methods of exposing thermometers since the time that regular observations of the weather had been made in this country. For many years open screens were most favored by meteorologists, that devised by Mr. J. Glaisher, F.R.S., and the late Astronomer Royal (Sir G. B. Airy) being the pattern principally used. In 1864 Mr. T. Stevenson, C.E., invented an admirable form of closed screen with lowered sides, which was considered preferable to the open type of screen, and has now almost entirely superseded the Glaisher Stand. In 1883 the Stevenson screen was considerably improved by a committee of the Royal Meteorological Society. Mr. Mawley then described his own experiments at Croydon and Berkhamsted, as regards this improved screen, known as the Royal Meteorological Society's pattern. He showed that the only two defects which had been attributed to this form of thermometer exposure were virtually non-existent, and therefore advised its general adoption both in this country and on the Continent. Mr. Mawley had recently made observations in the Stevenson screen, and also in the screens used in France and Germany, and the conclusion he had come to was that the results obtained in the Stevenson screen were not only the nearest to the true air temperatures, but also more likely to be strictly comparable with temperatures taken in a similar screen but with different surroundings elsewhere.

UNIVERSITY AND EDUCATIONAL NEWS.

THE will of the late Mrs. Horatio Lyon, of Springfield, Mass., gives, among other public bequests, $10,000 to Monson Academy, $10,000 to Pomona College and $10,000 to Menden Free Library.

HARVARD UNIVERSITY has received from Mr. J. Howard Nichols $5,000, to be used for the founding of a new scholarship, preference being given to a student from the State of Alabama.

THE will of tho late Charles Willard, of Battle Creek, Mich., leaves $40,000 to the Baptist College at Kalamazoo, Mich., and $40,000 for a library building for the city schools at Battle Creek, Mich.

THE new physiological and pathological laboratories of Queen's College, Belfast, were formally declared open on January 19th, and on the following day an address was made by Lord Lister. The building contains two floors about 80x40 feet in size, the lower one being devoted to physiological and the upper to pathological laboratories.

DR. L. A. BAUER has been appointed assistant professor of mathematics and mathematical physics at the University of Cincinnati. He will not enter on his new duties before September.

DR. R. W. T. GÜNTHER has been elected fellow of Magdalen College, Oxford, and tutor of natural science.

DISCUSSION AND CORRESPONDENCE.

COMPLIMENT OR PLAGIARISM.

WE have no occasion to withdraw any of our previous statements by reason of Professor Halsted's second communication.

We still maintain that "the same order may be found in Newcomb's Elements of Geometry." After proving that *by dividing the arc we divide the angle* and, conversely, *by dividing the angle we divide the arc*, Newcomb gives the following problems, which we compare with Halsted's:

NEWCOMB.	HALSTED.
PROBLEM I. *To divide a given circle into 2, 4, 8, 16, etc., equal parts.*	PROBLEM I. *To bisect a perigon.*
PROBLEM II. *To divide the circle into 3, 6, 12, 24, etc., equal parts.*	PROBLEM II. *To trisect a perigon.*
PROBLEM III. *To divide a circle into 5, 10, 20, etc., equal parts.*	PROBLEM III. *To cut a perigon into five equal parts.*
PROBLEM IV. *To divide a circle into fifteen, etc., equal parts.*	PROBLEM IV. *To cut a perigon into fifteen equal parts.*

Professor Halsted must think us very childish, indeed, if we assert that the word perigon is found in several geometries when the word is found in only Halsted's books and our own. He will find the word in Smith's Introductory Modern Geometry of Point, Ray and Circle, in Dupuis's Elementary Synthetic Geometry, in the later editions of Newcomb's Elements of Geometry, in Faifofer's Elementi di Geometria. But, perhaps, Professor Halsted will say, "All these books appeared after my Metrical Geometry in 1881, and these authors took the word from me." We have reason to believe that W. B. Smith, Newcomb and Faifofer all did see the word for the first time in Halsted's books.

The question then remains: "Where did Professor Halsted get it? Did he invent it, as he substantially asserts, or did he find it ready made?" This we cannot answer. We can only say we know where he might have found it.

In Sandeman's Pelicotetics, or the Science of Quantity, Cambridge [England], Deighton Bell and Co., 1868, which Professor Halsted might have seen in the Princeton University library, or in the Peabody Institute library at Baltimore, we read (page 304): "A PERIGON is the angle without any overlapping bounded by two straight lines lying in the same straight line upon the same side of their common end.

"A straight line being everywise alike upon all sides everywhere throughout is in any plane through it anglewise alike upon both sides at any point in it, and hence half a perigon or a HEMIPERIGON is the unoverlapping angle bounded by two straight lines lying in the same straight line upon opposite sides of their common end. A right angle is both one-half of a hemiperigon or a HEMISEMIPERIGON and one-fourth of a perigon."

That this same book was in the hands of Instructor Lefevre of the University of Texas, when he wrote his Number and its Algebra is fairly obvious from the following extract:

PELICOTETICS.	NUMBER AND ITS ALGEBRA.
"Driven to the * * * outrageously overtowering extravagance and absurdity of finding and raising high as a principle that a chain of reasoning to be strong and good need not have meaning in every link; that, in other words, the conclusiveness of an argument has nothing to do with the intelligibility of its several steps, or that things may be thoroughly made out true for reasons nowise to be understood."	"Accept the outrageous extravagance that a concatenation of deductions to be valid need not have meaning in every link; that a compulsory conclusion of an argument does not require intelligibility of its several steps; or that results may be thoroughly made out true for reasons nowise understood."

To us it seems well-nigh incredible that the man who made the important discovery in 1879 "that Princeton possesses * * * the identical volume from which the first translation of Euclid into English was made by Sir Henry Billingsley," and who, in 1896, "for four months * * * was buried in the uttermost parts of Hungary, Russia and Siberia," where he "made many important finds," could have failed to discover such an excellent word as 'perigon' in a book almost daily before his eyes.

BEMAN AND SMITH.

PROFESSOR JASTROW'S TEST ON DIVERSITY OF OPINION.

A DIVERSITY of answers is possible to Professor Jastrow's case of reasoning without being false in any one of them. Answers may de-

pend upon different assumptions regarding different parts of the argument.

Without going to the syllogistic part of the argument, it can be said at the outset that it is impossible to prove that *B* is *A* if *A* is *B*. Such a conclusion would violate the law of Conversion, unless the proposition *A* is *B* is a definition or exclusive. In the latter two alternatives it could be proved by the law of conversion. But Professor Jastrow gives an attempt to prove it syllogistically, that is, by *mediate* instead of *immediate* reasoning. As it is stated mediate reasoning is not applicable, because no middle term is given. Moreover, even immediate inference can do nothing until we know what kind of a proposition *A* is *B* is supposed to be. If it is the ordinary universal we cannot prove that *B* is *A*, for the reason mentioned. If it is a particular affirmative, a definition, or an exclusive proposition, it can be proved that *B* is *A* by immediate inference, and the error in the argument would be that it is an attempt at syllogistic or mediate reasoning where there is no middle term and where the attempt to supply it may be a *petitio principii*.

But, taking the syllogistic argument as it is given, it is intended as a case of prosyllogism and episyllogism connected with the disjunction that *B* is either *A* or not *A*. It is supposed, therefore, that the absurdity of the conclusion in the prosyllogism justifies the conclusion in the episyllogism, because that absurdity is assumed to show the absurdity of the first term of the disjunction, and hence the second would follow. But we must raise the question first whether the reasoning is formal or material.

In the prosyllogism the formal reasoning is perfectly correct. It is a case either of *E A E* of the First Figure or *A E E* of the Fourth Figure and is formally correct in either case. That is to say, with the premises given, the conclusion *A* is not *A* *does* follow, and there is no right to call it absurd, as Professor Jastrow does. It is an illustration of the fact that we must either impeach the premise or accept the conclusion. We cannot accept the premises and deny this conclusion at the same time. Hence, we may say either that one of the premises is a *petitio principii*, or the statement 'which is absurd' is a *petitio principii*.

There is only one way to establish a formal fallacy in this syllogism, and it is to assume that the major premises (major if the First Figure and minor if the Fourth Figure) is *O*, a particular negative. This will give *O A O* of the First Figure, or *A O O* of the Fourth Figure, in both a case of undistributed middle. But then, so far from making the conclusion absurd, as assumed here, it cannot be drawn at all. No conclusion whatever can be drawn under such conditions. Hence, if the propositions that *A* is not *A* be considered absurd it must be on other grounds than the formal reasoning, whether correct or incorrect. In fact, it is a manifest contradiction, but is not so because of the reasoning, but because the premise *B* is not *A* contradicts *A* is *B*. Technically it is the contradictory of the converse of *A* is *B*, and this makes the second premise a *contradictio in adjecto* of the first and, therefore, a *petitio principii*, a *material* fallacy.

Again, granting, on any grounds, that the conclusion of the prosyllogism is absurd, it is a *non sequitur* to infer from this fact that *B* is *A*, a *material* fallacy also. The temptation to accept it comes from the reflex influence of the assumed absurdity of the conclusion in the prosyllogism *A* is not *A*, upon the absurdity of the premise *B* is not *A*, the proposition that *A* is *B* not being questioned. But this only throws us back to a disjunctive syllogism as the only proper one in the case from which to attempt to draw the conclusion *B* is *A*, and thus nullifies the whole syllogistic procedure in the prosyllogism, as an *ignoratio elenchi*. The argument should proceed disjunctively, with the proposition *B* is not *A* as the minor premise of a disjunctive syllogism, and it would appear as follows:

B is either *A* or not *A*.
B is not *A*
$\therefore$ *B* is *A*.

But in this reasoning we have a violation of the principle in disjunctive reasoning; namely, the *modus tollendo ponens*. If we deny one term we must affirm the other. We deny the first term in the minor premise, and, as the second term is 'not *A*' (instead of *A*), when we affirm it, the conclusion must be *B* is not *A*, the same

as the minor premise, of course. But *B* is *A* is a *non sequitur*, both a formal and a material fallacy in the case. In fact, the instance is simply the common one for puzzling school boys.

It either rains or it does not rain.
It rains
∴ It does not rain.

The illusion is created by the failure to see that the principle of disjunction is not fulfilled by merely using the word 'not' before rains in the conclusion, when an additional negative is required by the dictum of this form of reasoning. The 'not' in this case is a part of the second term in the disjunction 'not rains,' and hence, when we follow the law of disjunctive inference, we should get 'It does not not rain,' or by double negatives 'It rains,' which is the true conclusion. So in Professor Jastrow's case. The *modus tollendo ponens* requires us to affirm the second term, which is 'not *A*,' and we get as the true conclusion *B* is not *A*, instead of *B* is *A*, which is a *nonsequitur*, as indicated.

But now, that I find that the conclusion is the same as the minor premise in the disjunctive reasoning, I may raise the further question whether there is not another material fallacy somewhere, since disjunctively I might get *B* is not *A*. In the instance before us this can be done, and in disjunctive inference the only fallacy that is most likely to occur is the *petitio principii*. The *non sequitur* will occur only when there is also a formal fallacy in it. Now, after assuming that *A* is *B*, it violates conversion to suppose that *B* is *A*, and it is a contradiction to suppose that *B* is not *A*. Hence with *A* is *B* as our premise, and *B* is either *A* or not *A* as the other; we have a *petitio principii* in the latter case. We might say that the disjunction is incomplete, which is possible if we assume that *A* is *B*, and which would only result in making the third alternative a particular proposition, *I* or *O*, with the formal fallacy mentioned in the prosyllogism, a *petitio principii* in the disjunctive syllogism, and a *non sequitur* in supposing that *B* is *A*.

JAMES H. HYSLOP.

COLUMBIA UNIVERSITY,
NEW YORK, January 15, 1897.

SCIENTIFIC LITERATURE.

Higher Mathematics. A text-book for classical and engineering colleges. Edited by MANSFIELD MERRIMAN, Professor of Civil Engineering in Lehigh University, and ROBERT S. WOODWARD, Professor of Mechanics in Columbia University. New York, John Wiley & Sons. 1896. 8vo. Pp. xi+576.

The appearance of this rather unique volume is significant as a proof of the rapid development of mathematical instruction in this country. It is designed for undergraduates who have mastered the elements of the differential and integral calculus. After referring to the danger of excessive specialization and to the desirability of guiding the student to 'a comprehensive view of the mathematics of the present day,' the preface sets forth the general scope of this work in the following passage, which, for several reasons, is worth quoting in full: "During the past twenty years a marked change of opinion has occurred as to the aims and methods of mathematical instruction. The old ideas that mathematical studies should be pursued to discipline the mind, and that such studies were ended when an elementary course in the calculus had been covered, have for the most part disappeared. In our best classical and engineering colleges the elementary course in calculus is now given in the sophomore year, while lectures and seminary work in pure mathematics are continued during the junior and senior years. It is with the hope of meeting the existing demand for a suitable text to be used in such upper-class work that the editors enlisted the cooperation of the authors in the task of bringing together the chapters of the book." The following synopsis of the chapters will give some idea of the contents of 'Higher Mathematics:' I. 'The solution of equations,' by Mansfield Merriman (32 pp.); II. 'Determinants,' by Lænas Gifford Weld (37 pp.); III. 'Projective geometry,' by George Bruce Halsted (37 pp.); IV. 'Hyperbolic functions,' by James McMahon (62 pp.); V. 'Harmonic functions,' by William E. Byerly (57 pp.); VI. 'Functions of a complex variable,' by Thomas S. Fiske (77 pp.); VII. 'Differential equations,' by W. Woolsey Johnson (71 pp.); VIII. 'Grassmann's space analysis,' by Edward W.

Hyde (51 pp.); IX. 'Vector analysis and quaternions,' by Alexander Macfarlane (42 pp.); X. 'Probability and theory of errors,' by Robert S. Woodward (40 pp.); XI. 'History of modern mathematics,' by David Eugene Smith (63 pp.).

That this collection of comparatively brief and disconnected chapters, however well they may be written, could be used successfully as a text-book may appear doubtful. Most of the chapters are too short to serve as a satisfactory text for a college course. Nevertheless, the work is an exceedingly valuable one. The advantage to be gained by putting into the hands of the student a work covering so wide a range, in a form so attractive and easily accessible even without the assistance of a teacher, can hardly be overestimated. Both as an incentive to further study and as a book of reference, the volume will be of great service.

The proper selection and apportionment of subjects for such a general introduction to higher mathematics is a matter of great difficulty; on the whole, the selection has been made with excellent judgment. It is certainly to be regretted that the proposed chapter on elliptic functions had to be omitted; the subjects treated in chapters I., II., IV., VIII. and IX. would have been missed far less. Modern analytic geometry, the theory of substitutions and groups with its applications, non-Euclidean geometry, quantics and theoretical mechanics were probably excluded as too advanced or as not allowing of brief presentation.

From the point of view of pure mathematics the most interesting chapters in the book are Professor Fiske's 'Functions of a Complex Variable' and Professor Halsted's 'Projective Geometry.' The geometric mode of treatment which characterizes the first third of Professor Fiske's chapter will arouse the interest and self-activity of the student and thus prepare him for the more arduous analytical investigation of the critical points of the simplest monogenic functions which occupies the remainder of the chapter. The whole is written with the greatest care, and although this is the longest chapter in the book one cannot help regretting that it is not longer. In but one or two cases conciseness seems to be carried so far as to endanger clearness—for instance, in the definition of uniform convergence (p. 274); but in general the presentation is as clear as it is precise.

Professor Halsted gives us a carefully worked-out exposition of von Staudt's system of synthetic geometry. The logical development, as was to be expected, is admirable; the form of presentation is exceedingly concise and neat. A mathematician familiar with the subject and with von Staudt's terminology may read this chapter with pleasure. But the beginner, for whom this volume is intended, will be sorely perplexed. Even if he has energy and patience enough to learn the new language here spoken, and comes to understand such phrases as "A tetrastim with dots in a conic has each pair of codots costraight with a pair of fanpoints of the tetragram of tangents at the dots" (Art. 91, p. 85), or "Two correlated polystims whose paired dots and codots have their joins copunctal are called 'coplanar'" (Art. 51, p. 76), of what use is this to him? Few persons will understand him, and he himself will be unable to understand the masters who have written, and are still writing, on the science of projective geometry. But, even apart from this passion for coining new words, it seems to the writer that the rigid formality and exclusiveness of the treatment here adopted tends to make a naturally easy and attractive subject unnecessarily difficult and almost forbidding to the beginner, and to give him a one-sided idea of what is now meant by projective geometry. To mention a minor point, a reference to von Staudt's 'Geometrie der Lage,' which, by a curious oversight, is nowhere mentioned, would have been in place in connection with the 'fundamental theorem' of Art. 59 (p. 77), which corresponds to von Staudt's Art. 88. The printer is probably responsible for assigning Pappus to the age of Plato (p. 104).

To the student of applied mathematics the chapters on 'Harmonic Functions' and on 'Probability and Theory of Errors' will prove of most value. The first half of Professor Woodward's chapter treats of the theory of probability proper, beginning with permutations and leading up to Bernoulli's theorem; the latter half, on 'laws of error,' is particularly valuable as embodying the results

of the author's own investigations on the errors of interpolated values. This chapter will form an excellent supplement to a course on the method of least squares.

Professor Byerly's chapter on harmonic functions is a model of clear and attractive exposition, in a subject by no means easy of approach to the beginner. It is, of course, largely based on the author's more extensive text-book. After showing on three particular examples how the attempt to solve certain physical problems naturally leads to Fourier series, to zonal and cylindrical harmonics, the author discusses each of these three subjects in some detail, illustrating every method by numerical examples, some of which are worked out even to the arrangement of the logarithmic work. Nothing could be more useful to the student of applied mathematics, while the pure mathematician may regret that the constant occupation with methods of solving certain problems leaves no room for inquiring into the real nature and characteristics of the functions under discussion. But, in a brief chapter, more than is here given could hardly be expected.

The introduction of numerous applications and exercises, which is a general feature of this volume, is also very prominent in Professor McMahon's chapter on hyperbolic functions. This chapter is perhaps more complete in itself than any other chapter in the book. It gives a very satisfactory exposition of the theory, with graphical representations, seven pages of tables and well-chosen applied problems.

Professor Johnson's excellent chapter on differential equations is naturally one of the longest in the book and also attains a certain degree of completeness.

On the other hand, Professor Merriman's chapter on 'the solution of equations' appears rather meagre, perhaps, because the author, as one of the editors, felt bound to keep strictly within the prescribed limits of space. A somewhat remarkable statement about the impossibility of the algebraic solution of the general quintic appears at the bottom of p. 22. After referring briefly to the researches of Abel and Galois, the author says: "Although these discussions are complex and not devoid of doubt," (a foot-note gives an inaccurate reference to Kronecker and a reference to Cockle), "they have been generally accepted as conclusive. Moreover, the fact that the quintic is still unsolved, in spite of the enormous amount of work done upon it during the past two centuries, is strong evidence that the problem is an impossible one." Comment is unnecessary.

The chapter on determinants contains more than might be expected from its brevity. Professor Weld's modesty in not referring anywhere to his text-book on the subject is worthy of mention.

The geometrical calculus is represented by two interesting chapters. The elements of Grassmann's methods as applied to plane and solid geometry are set forth at some length by Professor Hyde, while Professor Macfarlane treats of vector addition and multiplication, with particular reference to their application in mathematical physics. The quaternion proper, although it figures in the title of Chapter IX., receives but slight attention. Both chapters are far too brief to show the real power of these methods, which appears especially when geometrical differentiation and integration are introduced. The present writer cannot help regretting that Professor Hyde has not adopted the remarkably elegant and simple treatment of Grassmann's fundamental ideas proposed by Peano. From the point of view of pure mathematics Peano's method of laying the foundation for a geometrical calculus can hardly be improved upon. The physicist, however, will probably, for some time to come, prefer to become acquainted with vector analysis in close connection with the development of his physical and mechanical notions, in a manner similar to that pursued by Oliver Heaviside in his 'Electro-magnetic Theory,' Vol. I. (1893). Fortunately, Professor Macfarlane's methods and notations do not seem to differ now very much from Mr. Heaviside's. The peculiarly cumbrous notation for what might be called the polar coordinates of a vector is an exception.

In the last chapter Professor D. E. Smith gives a rapid survey of the historical development of the various branches of mathematics during the nineteenth century. This rather difficult task seems to be accomplished in a very satisfactory way, the chapter being evidently

based upon the best sources and made with great care. The chapter adds much to the value of this volume as a book of reference.

ALEXANDER ZIWET.

UNIVERSITY OF MICHIGAN.

The Development of the Periodic Law. By F. P. VENABLE, Ph. D., Professor in the Univerversity of North Carolina. Easton, Pa., Chemical Publishing Company. 1896. Pp. viii+321. Price, $2.50.

The purpose of this book cannot be better given than in the author's own words: "This work * * * is to be used for purposes of reference and of study, and not as a mere history of the subject. The errors and repetitions of the writers upon this subject in the past few years have abundantly proved the necessity for some such gathering and systematizing the work of former years."

Professor Venable's work in writing his recently published History of Chemistry has given him an excellent preparation for the critical study of the discovery and development of the periodic law, which is given in this volume. As stated by the author, much of the literature of the subject is in hidden and out-of-the-way places and a very real service is rendered to chemical science in thus coordinating it and making it more easily accessible. The scope of the book includes an account of the numerous attempts which have been made to discover numerical and other relations between the atomic weights and also an account of speculations as to the origin of the elements and their relation to some fundamental form of matter.

Calculations and speculations of this kind have had a fatal fascination for a great many chemists, and as we look over the literature and see how much has been written that is fanciful, and how much that in the light of better knowledge has been found erroneous and worthless, we are almost tempted to turn from the whole subject in disgust. And there is no doubt that many of these speculations have been worthless and the time of their authors has been nearly or quite wasted, for they have led to no accepted conclusions and they have given no incentive to useful work. But the periodic system stands on quite a different plane, for it furnishes us the best means at present available for coordinating our knowledge of the chemical elements, and it has furnished the incentive for a large amount of most excellent experimental work. That there are some imperfections in the system and that it does not, at present, give any accurate mathematical expression for our chemical knowledge must be admitted. It is tantalizing in its suggestiveness, and most chemists believe that it half reveals facts which will be of profound importance when fully understood. If the present work turns the attention of chemists in that direction it may prove very useful.

A quite full bibliography and an excellent index add to the usefulness of the work.

W. A. N.

Notes on Qualitative Analysis, arranged for the use of students of the Rensselaer Polytechnic Institute. By W. P. MASON, Professor of Chemistry. Third Edition. Easton, Pa., Chemical Publishing Company. 1896. Pp. 56. Price, 80 cents.

This book gives a concise statement of the more important qualitative tests for metals and acids, those for the metals being arranged in the order of Fresenius. Then follow tables for analysis of metals, and five pages giving very short directions for the analysis of alloys, insoluble substances and alkaline solutions.

The selection of tests is satisfactory and the book will, doubtless, furnish a basis for a good short course in the subject. It would seem, however, that even an elementary work should give directions which are reliable for cases of very common occurrence. For instance, ammonia often fails to separate small quantities of silver chloride from mercurous chloride; and ammonia will not separate zinc from chromium unless the zinc is in excess. Neither case is provided for in the directions given.

Books of this character may furnish students with excellent drill in scientific methods of work and, in the hands of a good teacher, are satisfactory from that standpoint, but the student should understand that he is liable to fall into very serious mistakes if he attempts to use the directions for practical work.

The references to Watts' dictionary and the

chemical journals form an excellent feature of the book. The habit of going to proper sources for fuller information cannot be formed too early and is of fundamental importance to any one hoping to do scientific work.

W. A. N.

A Manual of Quantitative Chemical Analysis, for the use of Students. By FREDERICK A. CAIRNS, A. M., Late Instructor in Analytical Chemistry in School of Mines, Columbia College. Third edition. Revised and Enlarged by ELWYN WALLER, Ph.D., formerly Professor of Analytical Chemistry in School of Mines, Columbia College. New York, Henry Holt & Co. 1896. Pp. xii+417.

This work was first published in 1880. In the thorough revision, which has become necessary, a considerable portion has been rewritten and additional chapters have been inserted, while the portion upon organic proximate analysis has been omitted.

The book is evidently intended for use in training those who intend to use their knowledge of analytical chemistry along commercial lines. After an introduction of twenty-two pages, ten chapters are given which contain directions for the complete analysis of a series of pure salts, including directions for the determination of seventeen elements. Then follows the main portion of the book, with chapters giving detailed directions for the analysis of limestones, clay, ores, metals and alloys as found in commerce, potable and mineral waters, acids and alkalies, bleaching powder, fertilizers, coal and commercial nitrates.

The selection of topics is such as to meet very satisfactorily the need of the practical chemist, and the directions given are clear and sufficiently full for beginners. The appendix, by Professor Waller, giving the properties of precipitates is an especially valuable feature of the book.

It would be impossible for any one to write a book covering such an multitude of details as are required in quantitative analysis and give directions which accord, in every case, with the best knowledge of the subject. Two cases which may be criticized on this ground are worthy of notice because of their importance. Gladding has shown (J. Am. Ch. Soc., 17, 398) that barium chloride should be added very slowly to secure a pure precipitate of barium sulphate, and Jannasch and Richards (J. Prak. Ch., 39, 321) and Schneider (Z. f. Phys. Ch., 10, 425) have shown that the barium sulphate precipitated in presence of ferric salts contains ferric sulphate, which loses sulphuric acid on ignition and renders a subsequent purification by fusion inaccurate. The other case is that of the Lindo-Gladding method for the determination of potassium. It has been shown that the method is inaccurate because the potassium of the chloro-platinate is partly replaced by ammonium on washing with ammoniums chloride.

Since Ostwald has pointed out so clearly the value of the new theories of physical chemistry for the practical discussion of many topics in analytical chemistry, it is to be hoped that some discussion of that sort may soon find its way into our text-books. The present book is neither better nor worse than others in that regard.

W. A. N.

SCIENTIFIC JOURNALS.

THE AUK, JANUARY, 1897.

THE number contains articles of varied interest. Mr. E. W. Nelson describes some forty new species and subspecies and one new genus of birds from Mexico and Guatemala, collected by himself and Mr. E. A. Goldman during explorations conducted for the Biological Survey of the United States Department of Agriculture during the last five years. These collections include between four and five thousand specimens, many of them collected in districts never before visited by an ornithologist. Dr. A. P. Chadbourne concludes his paper, begun in the October number, on 'Evidence suggestive of the Occurrence of Individual Dichromatism in *Megascops asio*.' This paper is illustrated with a colored plate. Two captive individuals of this species, fed on an exclusive diet of liver, were observed to change from the gray to the red phase without any evidence of molting. Other technical papers treat of various questions of nomenclature and include descriptions of a new subspecies each of the Yellow and Black-throated Blue Warblers.

Papers of a more popular character include 'Notes on a Captive Hermit Thrush,' by Daniel E. Owen; 'Recent Investigations of the Food of European Birds,' by F. E. L. Beal; 'Some Notes on the Nesting Habits of the White-tailed Kite,' by Chester Barlow; 'Report of the A. O. U. Committee on Protection of North American Birds,' by William Dutcher, and an account of the 'Fourteenth Congress of the American Ornithologists' Union,' by the Secretary, John H. Sage. Mr. Owen's experiments with the Hermit Thrush go to show that its digestion is extremely active, blueberries being found to traverse the digestive tract in one hour and a-half; also that its capacity for food was enormous, it being capable of digesting its own weight of raw meat daily. The report of the Committee on Bird Protection shows that much work is being done in behalf of the preservation of wild birds, with, in many cases, highly encouraging results. The protection of the colonies of Terns at Muskeget Island, Massachusetts, and Great Gull Island, New York, has been continued, and both colonies give evidence of considerable increase.

Under 'General Notes' is the usual variety of short communications giving items of interest respecting various rare species or the capture of species at unusual localities; under 'Recent Literature' a dozen pages are devoted to reviews of recent ornithological publications. The number closes with the 'Eighth Supplement to the American Ornithologists' Union Check List of North American Birds,' occupying twenty pages, and adding several newly recognized genera and subgenera and some twenty species and subspecies to the Check List. Also two subgenera are raised to the rank of genera, and three generic names are changed, involving changes in the names of nine species; while the names of twenty other species and subspecies are also changed, mainly through the discovery of earlier names than those previously adopted in the Check List. The additions and mutations thus number nearly seventy. Besides this, six recently described species and subspecies, and nine proposed changes of nomenclature, are treated as not entitled to adoption; while nearly a dozen other cases are deferred for final action later. Thus, within the two years that have elapsed since the publication of the Seventh Supplement to the Check List, it appears that nearly one hundred cases have arisen requiring action by the A. O. U. Committee on Nomenclature; showing, for one thing at least, no lack of activity on the part of workers in North American ornithology.

JOURNAL OF GEOLOGY, JANUARY–FEBRUARY, 1897.

Comparison of the Carboniferous and Permian Formations of Nebraska and Kansas: By Charles S. Prosser. The classification of the Carboniferous and Permian worked out in Kansas by the author is extended to cover the corresponding beds of Nebraska. In this opening paper the details of the formations as they occur in Nemaha, Johnson, Gage and Otoe counties are given, with many facts of historical and local interest.

Evidences of Recent Elevation of the Southern Coast of Baffin Land: By Thomas L. Watson. The author, a member of the Cornell Greenland expedition, concludes: (1) There is conclusive evidence of a recent elevation of 270 to 300 feet along the south and southeast coast of Baffin Land, as indicated by raised beaches, differential weathering and remains of living genera and species in beds associated with the beaches. The movement seems not to have been everywhere alike, but was only in part slow and gradual. (2) Conditions strongly favor a permanent movement on Big Island and in Cumberland Sound. (3) The Baffin Land uplift was probably coextensive with that described by Bell and Tyrrell in the Hudson Bay region. The paper includes a partial bibliography.

Italian Petrological Sketches, III: By Henry S. Washington. The author continues his discussion of Italian volcanics, treating the Bracciano, Cerveteri and Tolfa regions. Tosconite, an acid effusive characterized mineralogically by the presence of basic plagioclase as well as orthoclase with occasional quartz and chemically by high silica and alkalies and (for the acidity) high lime and low alumina, is defined. The rock is the equivalent of Brogger's quartz-trachyte-andesite and approaches his dellenite. The accompanying rocks are described

in detail and the paper includes seven excellent analyses.

Mode of Formation of Till as Illustrated by the Kansan Drift of Northern Illinois: by OSCAR H. HERSHEY. The following stages are distinguished: (1) The residuary clay is crushed and kneaded, perhaps moved a short distance, but remains free from foreign material. (2) The process is continued, foreign material is added, and there is greater, probably sub-glacial, transformation. This is believed to be represented by most of the till of Stephenson County. (3) Calcareous material is deposited in the till from solution. (4). The horizontal rock caps of the preglacial hills are pushed forward, and titled. (5) These rock masses become fractured and are rolled and kneaded together. (6) By a continuation of the process a very stony till relatively free from foreign rocks is formed. (7) The angular limestone débris becomes commingled with 10 per cent. to 50 per cent. of rounded Canadian pebbles. (8) The red clay, stage 2, may become mixed with the angular limestone, stage 6. (9) Preglacial and marginal lake-bed silts become mixed with the till forming the yellow clay frequently considered to be englacial. Deposition is considered to be largely marginal and mainly subglacial.

The Geology of the San Francisco Peninsula: by HAROLD W. FAIRBANKS. Lawson's* report upon the geology of the peninsula is criticised, the author taking exception to the use of the term chert and the reference to the siliceous bands in the foraminiferal limestone as veins. He dissents from the reference of the origin of the jaspers to siliceous springs on the bottom of the ocean and urges that they were formed from radiolarian and other siliceous remains dissolved in sea water. The 'silica-carbonate sinter' deposits are held to be of recent origin and hence of no value as a base for the correlation of the Knoxville and Franciscan series (Golden Gate Series of Fairbank). It is believed that Professor Lawson has unduly minimized the importance of the disturbances which the older uncrystalline rocks show. Attention is called to the absence of any new evidence for continuing to place the Series in the Cretaceous, and the use of the term laccolith in describing the intrusives is deplored. The granite of the Golden Gate Series is held to be older than those of the Sierra Nevada rather than of the same age. H. F. B.

* Fifteenth Ann. Rept., U. S. Geol. Surv., pp. 405–476.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES.—SUB-SECTION OF ANTHROPOLOGY AND PSYCHOLOGY.

THE Academy met at Columbia University on Monday evening, January 25th, with President Stevenson in the chair. The Sub-section of Anthropology and Psychology immediately organized under the chairmanship of Professor F. H. Giddings and proceeded to the regular program, which consisted of reports upon the winter meetings of the various scientific associations represented in the Section. The first report was by Professor Giddings, upon the meeting of the American Economic Association in Baltimore. The speaker paid particular attention to the presidential address of Professor Henry C. Adams, on 'The Relation of Economics to Jurisprudence;' to the paper of ex-Secretary of the Treasury Charles S. Fairchild on 'What is the Present Direction of Acquisitive Investments? What are the Economic Effects of Such Investments?' and to Professor Arthur T. Hadley's paper on 'The Duty of the Government towards the Investor.'

Dr. Livingston Farrand presented brief abstracts of the more important psychological papers read at the meeting of the American Psychological Association in Boston, December 29 and 30, 1896, and was followed by Dr. Franz Boas, who spoke of the meeting of Section H (Anthropology) of the American Association for the Advancement of Science, in New York, approving the action of the Section in recommending a regular winter meeting, to be held, if possible, at the same time and place as the American Psychological Association and the American Society of Naturalists, and reviewing briefly some of the papers presented at the meeting.

Mr. Harlan I. Smith reported on the American Folk-Lore Society's meeting in New York, on December 20th, dwelling particularly on Miss Fletcher's paper, 'Certain Early Forms of Ceremonial Expression,' and on the discussion

following Dr. Brinton's and Dr. Boas' papers, as to the validity of the theory of the psychic unity of man in accounting for details of similarities in the mythologies of widely separated peoples.

LIVINGSTON FARRAND,
Secretary of Sub-Section.

TORREY BOTANICAL CLUB, TUESDAY, JANUARY 12, 1897.

THIS was the annual meeting. Six new active and two corresponding members were elected. Resolutions of sorrow were adopted regarding the death of Mr. William H. Rudkin, one of the oldest members, the discoverer of the hybrid oak *Quercus Rudkini*. Annual reports were presented by the standing committees and officers. It was resolved to print a list of the desiderata of the herbarium of plants growing within 100 miles of the city. The Treasurer reported a cash balance of $56.89 in the regular fund and $514.14 in the Buchanan fund.

The Recording Secretary, Dr. Rusby, reported an average attendance of 31 persons at the 15 meetings held during the year, two deaths, a net gain in active membership of 28, a present active membership of 219, corresponding membership 150, honorary membership 4, scientific papers presented 37, of which 22 had been published. Several hundred new species and a number of new genera had been communicated, and there had been a marked increase in the attention given to anatomical and cryptogamic subjects.

The editor reported that Vol. 23 of the *Bulletin* had aggregated 548 pages and 34 full-page plates, and that two numbers of the *Memoirs*, aggregating 206 pages, had been issued. There was a cash balance from publications of $48.09 in addition to the balance already reported by the Treasurer.

The officers for 1897 were elected as follows: President, Addison Brown; Vice-Presidents, T. H. Allen, H. H. Rusby; Treasurer, Henry Ogden; Recording Secretary, Edward S. Burgess; Corresponding Secretary, John K. Small; Editor, N. L. Britton; Associate Editors, Emily L. Gregory, Arthur Hollick, Anna M. Vail, B. D. Halsted, Lucien M. Underwood; Curator, Helen M. Ingersoll; Librarian, William E. Wheelock.

The scientific programme of the evening was then taken up as follows:

By Mr. A. J. Grout, 'Notes on Some American *Brachythecia*.'

By Dr. N. L. Britton, *Linum Virginianum* and its Relatives.'

Mr. Grout compared the principles of classification employed by the two prominent bryologists, Schimper and Lindberg, and stated his reasons for preferring those of the latter to those of the former. He then exhibited and remarked upon four American species of *Brachythecium* and expressed the opinion that they represent a genus distinct from *Brachythecium*. The paper will be published in full in the *Bulletin*.

Dr. Britton illustrated the leading distinguishing characteristics between the species of *Linum*, of the *Virginianum* group, and dwelt particularly upon the claims to specific rank of *L. Virginianum medium*, Walter.

EDWARD S. BURGESS,
Secretary.

NEW BOOKS.

A Dictionary of Birds. ALFRED NEWTON, assisted by HANS GADOW. With contributions from RICHARD LYDEKKER, CHARLES S. ROY and ROBERT W. SHUFELDT. Part IV., Sheathbill-Zygodactyli. London, Adam and Charles Black; New York, The Macmillan Company. 1897. Pp. 833–1088 + viii + 124. $2.60.

Experimental Morphology. Part I., Effect of Chemical and Physical Agents upon Protoplasm. CHARLES BENEDICT DAVENPORT. New York, The Macmillan Company. 1897. Pp. xiv + 280.

Travels in West Africa, Congo Français, Corsica and Cameroons. MARY H. KINGSLEY. New York, The Macmillan Company. 1897. Pp. xvi + 743.

Elementary Geology. RALPH S. TARR. New York, The Macmillan Company. 1897. Pp. xxx + 499. $1.40.

Catalogus Mammalium. E. L. TROUESSART. Fasciculus I. Berlin, R. Friedländer & Sohn. 1897. Pp. v + 218. M. 10.